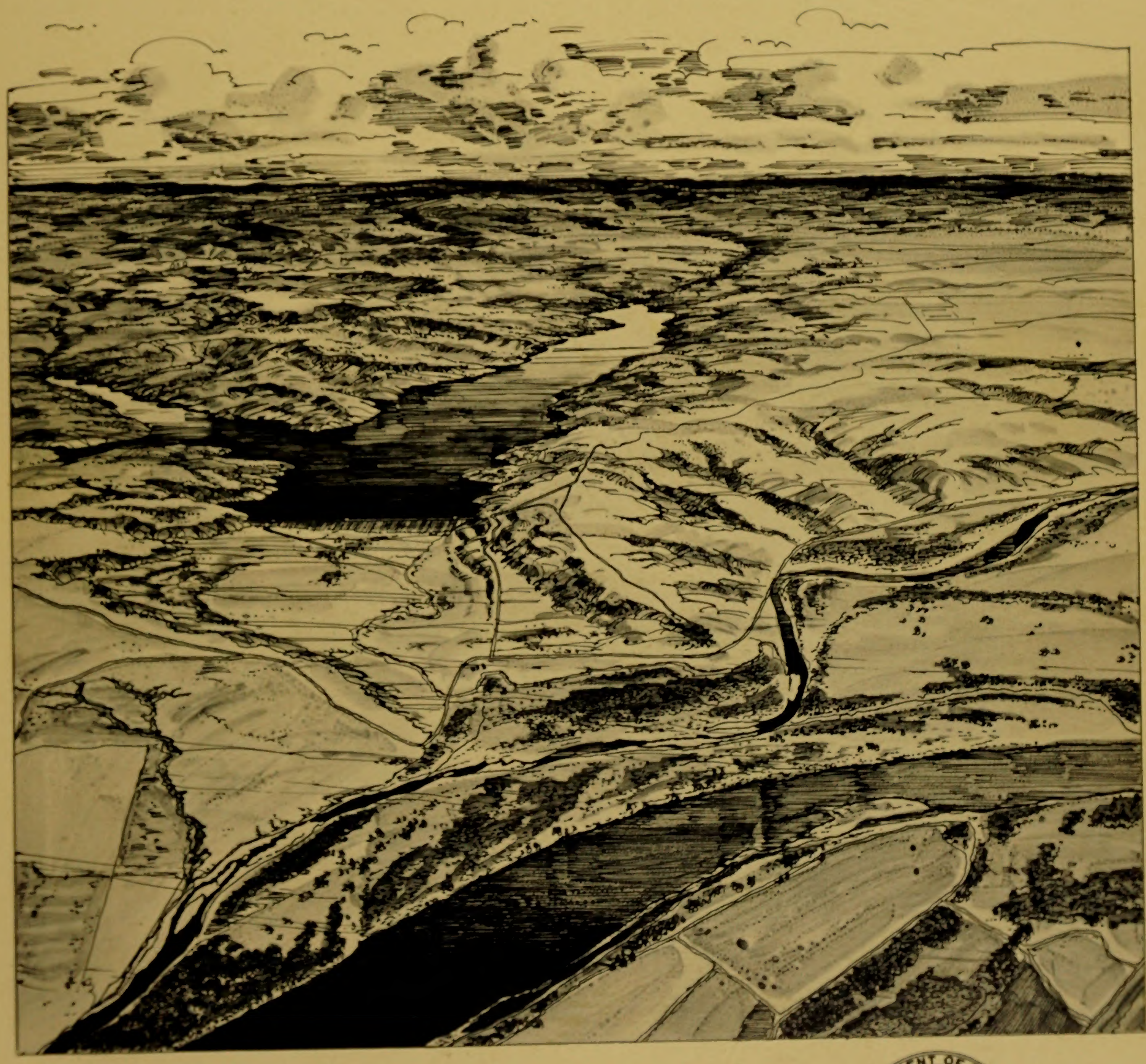
Draft Environmental Statement

Yellowstone Diversion Project
Dawson County, Montana

Intake Water Company



U.S. Department of Interior

Bureau of Reclamation

ENVIRONMENTAL STATEMENT ON THE YELLOWSTONE DIVERSION PROJECT DAWSON COUNTY, MONTANA

INTAKE WATER COMPANY

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U.S. Army Corps of Engineers
U.S. Bureau of Land Management
U.S. Fish and Wildlife Service

ABSTRACT: This Statement analyzes the environmental impacts of the proposed Yellowstone Diversion Project facilities and offstream storage of Intake Water Company's (IWC's) existing appropriation of 80,650 acre-feet per year (ac-ft/yr) of water from the Yellowstone River in eastern Montana. Alternatives examined include no action, water sources, and project sites. The proposed facilities, which include an earthen dam and associated offstream regulating reservoir of approximately 750 acres; a diversion, intake screening and pumping facility; 2.2 miles of two parallel 42-inch diameter pipelines; and a 4-mile electric transmission line, are designed to provide about 78,000 ac-ft of water on a firm annual yield basis to potential industrial, municipal, and agricultural users in IWC's intended service area, located within portions of Dawson and Wibaux Counties in Montana, and portions of Golden Valley County, North Dakota.

This statement is intended to serve as the environmental review or consultation vehicle to comply with the Clean Water Act.

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SUMMARY

The need to develop firm annual yield water supplies for distribution in the Wibaux, Montana and Beach, North Dakota region stems from the expected growth of the regional economy and development of area energy resources. It is anticipated that development of these resources and consequent population and economic growth would require more than 30,000 acre-feet per year (ac-ft/yr) of water by the year 2000. The purpose of the Yellowstone Diversion Project (YDP) proposed by Intake Water Company (IWC) is to provide a reliable source of water capable of meeting the requirements of this area.

To meet these needs, IWC proposes to divert up to 80,650 ac-ft/yr of water from the lower Yellowstone River near Intake, Montana at a maximum diversion rate of 200 cubic feet per second (cfs), store it in an offstream reservoir to be constructed nearby, and provide water on a firm annual yield basis for any beneficial use. The project would make water available for a predicted demand; however, there are no direct connections of the YDP with any specific project, end use or users that may have a need for this water.

For the purpose of this Environmental Impact Statement (EIS), the proposed federal action is defined as granting or denying the necessary permits sought for the project. Right-of-way (ROW) permits are required because approximately 95 acres (ac) of Bureau of Reclamation (BR) lands and 40 ac of Bureau of Land Management (BLM) lands would be affected. In addition, permits are required from the U.S. Army Corps of Engineers (USCE) to construct the project facilities. As the lead federal agency, the BR has previously issued IWC a license to utilize the point of diversion on the lower Yellowstone River located on Joe's Island subject to stipulations, including completion of an approved EIS. The intent of this document is to analyze the impacts that may occur if all requested permits were approved and the project were to be developed.

The alternatives examined include "No Action", Preliminary Alternatives (which were discarded), and Alternative Reservoir Locations.

The "No Action" Alternative, which would preclude project development, could be implemented either by IWC or the BR. Should the BR select this alternative action, the requested permits would be denied.

Preliminary alternatives which were examined include groundwater and surface water sources other than the Yellowstone River. These were eliminated from further consideration because of:

1) inadequate and unreliable firm annual yield;
2) unreliable water quality;
3) environmental impact with associated project development; and
4) costs of development.

The area of the lower Yellowstone River proximal to the intended service area was examined for a potential point of diversion. The point of diversion on Joe's Island (which was specified in the Notice of Appropriation filed 8 June 1973 and upheld as an existing water right by the Montana Supreme Court) was selected for the following reasons:

1) consistent water elevations;
2) channel morphology conducive for intake construction;
3) proximity to intended service area;
4) proximity to potential reservoir sites; and
5) overall project costs.

Because no water sources could furnish an uninterruptable supply of water during low flow conditions, IWC studied three alternative reservoir locations within the Box Elder Creek drainage: Denny's, Belle Prairie, and Box Elder, each with storage capacities of 27,000, 20,500 and 25,000 ac-ft, respectively.

The Denny's Alternative was eliminated because:

1) site investigations and economic evaluations revealed that the Denny's site would develop water at the highest cost;
2) construction of 2 miles (mi) of access road through rugged terrain would adversely contribute to environmental impacts; and
3) cultural resource surveys identified areas of cultural value in and around the site.

The Belle Prairie Alternative was examined in greater detail. Geotechnical investigations revealed thick alluvial deposits underlying the entire reservoir area. This alternative was eliminated because these conditions would allow excessive rates of seepage losses beneath the dam and around the reservoir. Therefore, it was determined that this alternative would be unfeasible.

The Box Elder Preferred Alternative was investigated and found to be a suitable site. Project facilities of this preferred alternative include:

1) a reservoir of approximately 25,000 ac-ft covering 750 surface ac;
2) a 2300-ft long, 100-ft high earthen dam with embankment protection;
3) construction of outlet works and pump station below the dam;
4) diversion and pumping facilities on Joe's Island capable of diverting water at a maximum rate of 200 cfs;
5) approximately 11,700 ft of two parallel 42-in buried pipelines;
6) a transmission line of approximately 4 mi; and
7) construction of a side channel bridge and access road on Joe's Island.

Potential impacts associated with the preferred alternative have been analyzed and, where possible, mitigative measures have been recommended and agreed upon. The following include these potential impacts and mitigative measures.

1) Affected land for the project would include 891 ac. Of that, it is anticipated that 86 ac would be revegetated following construction of facilities. Federal lands involved in the project include 95 ac of BR lands on Joe's Island and in the reservoir site and 40 ac of BLM lands in the reservoir site.

2) Access to the Island pumping station would be from an all-weather bridge and gravel road paralleling the pipeline corridor. The gravel road would be constructed to existing contour so as not to impede flood or ice flow. Access to the reservoir would be from existing roads and trails.

3) Potential impacts of the project on the Yellowstone River include: no predictable effects on flood flow and/or ice movement; reduction in annual yield of 80,650 ac-ft/yr; no impact on senior water rights; no anticipated effect on channel characteristics; maximum stage decrease (withdrawal of 200 cfs at flow of 2200 cfs) of 0.75 to 0.8 in and maximum decrease in wetted perimeter of 1.5 to 4.0 ac/river mi during at least one day per year based on the majority of years in the period of record; maximum decrease in flow velocity less than 0.1 ft/sec; negligible effect on water quality from construction disturbance and reduction in annual yield.

4) Potential impacts of the project on Box Elder Creek include: inundation of 4.1 stream mi; 1.6 mi of creek below the dam is anticipated to become perennial due to seepage and natural flows of the creek being passed through the reservoir; water quality changes in the lower 1.6 mi would reflect water quality of the reservoir and would include a slight decrease in summer temperature, dissolved oxygen, pH, and suspended solids with a slight increase in dissolved solids; substrate of the lower 1.6 mi would maintain sands and gravels with limited sedimentation.

5) The reservoir would cause a minimal increase in subsurface groundwater levels within lateral and downstream areas. Drains and a cutoff trench would limit downstream seepage (calculated to be less than 100 ac-ft/yr). Seepage of higher quality surface water would improve groundwater quality.

6) Eight vegetation types within the 891 ac would be affected by the project including big sagebrush-saltbush-rabbitbrush (60 ac), silver sagebrush grassland (600 ac), upland grassland (15 ac), juniper breaks (14 ac), hardwood draw (161 ac), dryland cropland (2 ac), riparian forest (33 ac), and rose-snowberry (6 ac). Revegetation of disturbed areas would be accomplished by seeding with approved species.

7) Potential impact on wildlife include loss of habitats described above; loss of a limited number of immobile mammals from construction; limited potential impact on birds from transmission line collision; increased potential for hunting, poaching, and human disturbance from project related access of Joe's Island and the reservoir site; reduced grazing and improved habitat on land purchased but not needed for project purposes.

8) Potential impacts to aquatic environs include: Negligiable impacts to the Yellowstone River from limited disturbance, sedimentation control, and limited loss of wetted perimeter due to withdrawal; conversion of 4.1 mi (5.0 ac) of Box Elder Creek habitat to reservoir habitat; 1.6 mi of Box Elder Creek becoming perennial stream habitat; loss of potential fish migration within lower Box Elder Creek; increased potential for fishing from project related access of Joe's Island; creation of reservoir sport fishery; minimizing impact to downstream fish spawning habitat during April and May by limiting withdrawal (whenever possible) to river flows of greater than 5000 cfs; intake structure design to minimize impingement and entrainment of fish.

9) No impact on threatened or endangered plant or animal species.

10) No impact on prime farmlands.

11) Creation of approximately 120 temporary construction related jobs. Negligible impact on existing community infrastructure due to construction or operation of the project.

12) Potential improvement to area recreation from increased opportunity of hunting, fishing and boating by providing access and facilities on Joe's Island and the reservoir site.

13) Positive affects of project construction and operation on the regional economy through employment and increased tax base; loss of grazing potential from development of project lands; reduction of annual hydropower generation on the Missouri River; energy consumption to pump water to reservoir; no impact to mineral development on project related lands.

14) Screening of facilities with trees and painting structures to blend into the surroundings would minimize deterioration of visual quality.

15) No significant cultural resources are present on the project site.

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LIST OF ABBREVIATIONS

ac	acre
ac-ft	acre-foot, acre-feet
ac-ft/yr	acre-feet per year
BLM	Bureau of Land Management
BR	Bureau of Reclamation
cfs	cubic feet per second
cu yds	cubic yards
dB	decibal
DHES	Montana Department of Health and Environmental Sciences
DNRC	Montana Department of Natural Resources and Conservation
EAR	Environmental Assessment Report
EIS	Environmental Impact Statement
fps	feet per second
ft	foot, feet
gal	gallon
gpm	gallon(s) per minute
in	inch(es)
IWC	Intake Water Company
kV	kilovolt
LYID	Lower Yellowstone Irrigation District
mgpd	million gallons per day
mi	mile(s)
MDFWP	Montana Department of Fish, Wildlife and Parks
MPDES	Montana Pollutant Discharge Elimination System
mph	mile(s) per hour
msl	mean sea level
NEPA	National Environmental Policy Act
RCM	Revised Codes of Montana, 1947
ROW	right-of-way
sq ft	square foot, feet
sq mi	square mile(s)
TDS	total dissolved solids

LIST OF ABBREVIATIONS (Concluded)

TPD	tons per day
TPY	tons per year
USCE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USLE	Universal Soil Loss Equation
YDP	Yellowstone Diversion Project

I. PURPOSE AND NEED OF THE YELLOWSTONE DIVERSION PROJECT

A. INTRODUCTION

1. Proposed Federal Action

For purposes of this Environmental Impact Statement (EIS), the "proposed federal action" is defined as granting or denying Intake Water Company (IWC) a right-of-way (ROW) for a period of 40 years to construct, operate and maintain a pumping station, water pipeline, and storage reservoir on approximately 95 acres (ac) of land administered by the Bureau of Reclamation (BR) and 40 acres administered by the Bureau of Land Management (BLM). The ROW permit will also include permission for IWC to construct an all-weather access to the pumping site and permission for Montana-Dakota Utilities to construct an electric transmission line to the pumping and dam sites. An additional federal action will also be necessary from the U.S. Army Corps of Engineers (USCE) to issue a Section 404 permit for construction of the intake structure and dam, and a Section 10 permit for construction of the intake structure, access bridge, and transmission line crossing of the Yellowstone River. A list of all federal and state permits required for the project is included in Appendix B. These permits will be based on commitments to protect the environment as described in Appendix C of this document. The Bureau of Reclamation has reviewed and accepted the analysis of project impacts from Espey, Huston & Associates, Inc. under the third party agreement for development of this EIS.

USCE and BLM were requested by letter, dated May 21, 1982, to review a preliminary draft of this document and advise whether it met their needs for premitting and right-of-way issuance. Their responses are included in Appendix B. Information concerning cumulative impacts and land ownership, which was requested as a result of their review is included in this document. In compliance with Executive Order 11988, BR has considered the effects of the project on floodplain management. There are no alternatives for the pumping station other than the Yellowstone River floodplain; the project should not lead to human habitation of the floodplain and facilities will be designed to minimize damage from floods.

2. Need for Federal Action

IWC holds an existing water right at the point of diversion on Joe's Island near Intake, Montana, as specified in the Notice of Appropriation and additionally holds a ROW permit issued by the Bureau of Reclamation (Exhibit B-1, Appendix B) to utilize this diversion point (as long as stipulations outlined in the permit are met). This EIS describes the impacts that would occur if all requested permits are approved and discusses alternative project sites and alternative federal actions which the Secretary of the Interior could take. Following this analysis, the decision on utilizing federal lands for the project will be made. This EIS is written in compliance with the National Environmental Policy Act (NEPA) of 1969, as amended (42 U.S. 4321 et seq), and the regulations of the Council on Environmental Quality (40 CFR 1500 et seq).

B. APPLICANT'S PROPOSAL, PURPOSE AND NEED

The Yellowstone Diversion Project (YDP) is a water storage and supply project proposed by IWC. The purpose of the YDP is to provide a reliable source of water to the intended service area in portions of Dawson and Wibaux Counties in Montana, and Golden Valley County, North Dakota (Figure I-1). To this end, IWC will divert up to 80,650 acre-feet per year (ac-ft/yr) of water from the lower Yellowstone River near Intake, Montana, store it in an offstream regulating reservoir to be constructed nearby, and provide water on a firm annual yield for sale, rent, and distribution for irrigation, municipal, domestic, or industrial uses. The project will make water available for a predicted demand; however, at the present time, there are no direct connections of the YDP with any specific projects, end use, or user that may have a need for this water. IWC is a water supply company and is not in the business of providing energy or other industrial products, growing agricultural products, or providing municipal and domestic services. It is, however, in the business of assessing probable needs for its product (water) and developing a reliable supply to meet those probable needs. As such, the potential needs of the intended service area were assessed for the uses identified above to determine if it was economically feasible to develop firm yield water supplies.

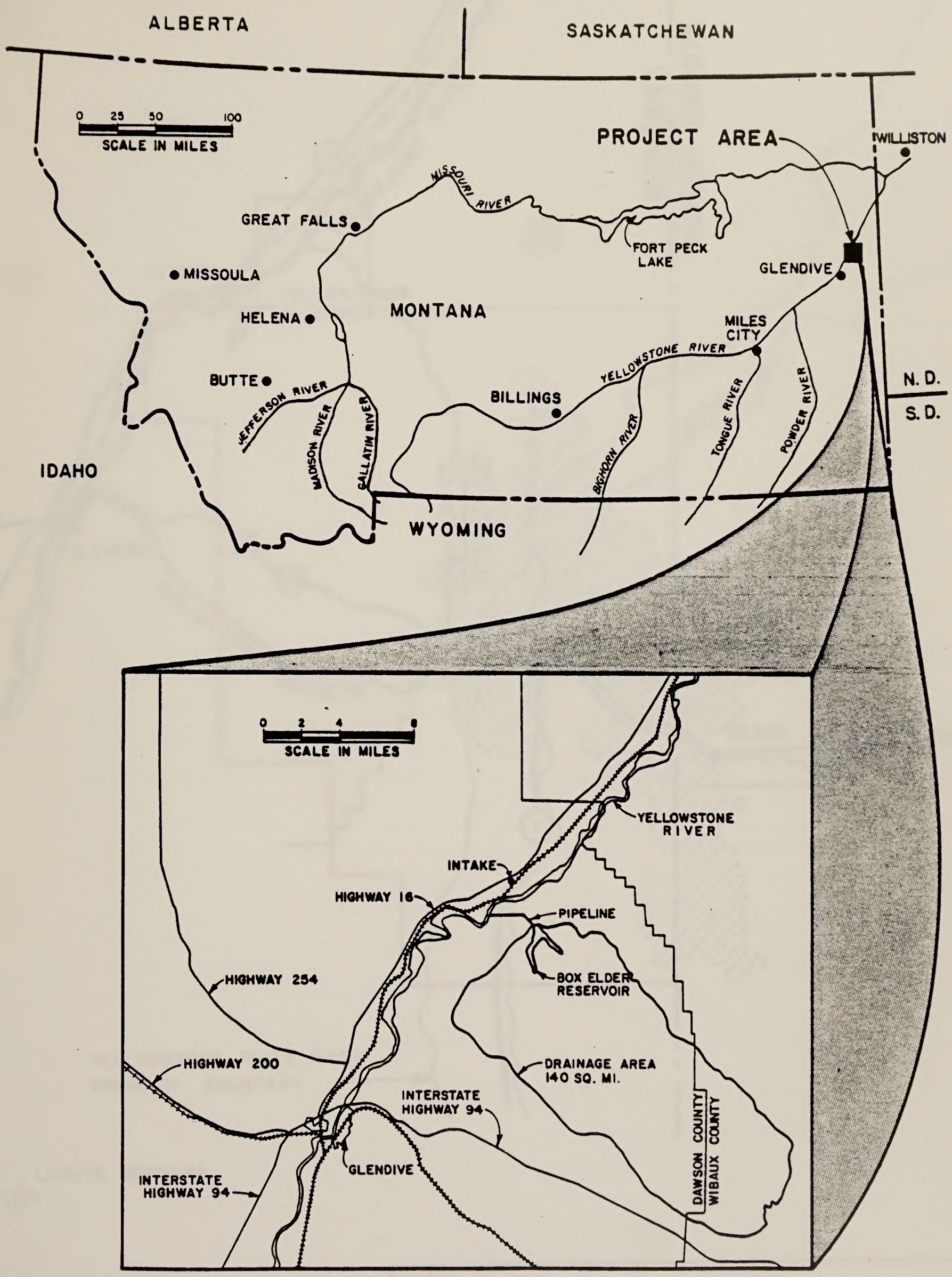
The need for dependable water supplies within IWC's intended service area has been documented by several studies completed in the mid-1970's (1, 2, 3). It is envisioned that many areas of the regional economy (i.e., industrial, municipal and service sectors) will grow as the regionally located energy deposits are developed to meet increasing domestic needs. Tenneco Coal Gasification Company has announced plans for the possible construction of a coal gasification facility to be located in Wibaux County, Montana within the service area of IWC and is a potential user of this water. Water made available through construction of the YDP may potentially supply a substantial portion of those and other requirements.

A firm yield water supply is needed because:

1) The quantity of water necessary to meet the growing needs is not available from groundwater and undeveloped surface-water sources; and

2) Time is required to develop quantities of suitable quality water and is a critical factor in developing the energy resources in IWC's intended service area.

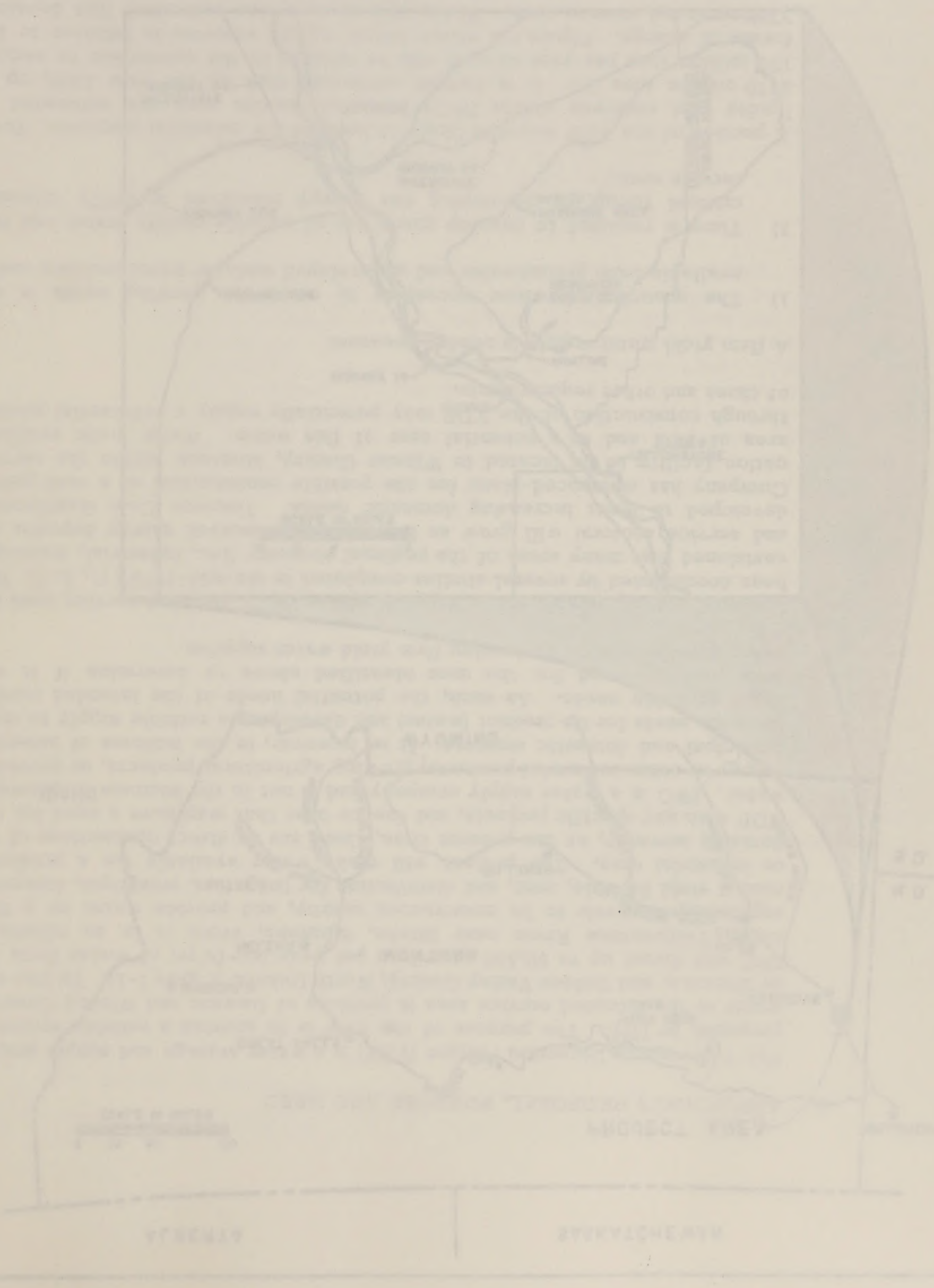
A portion of the YDP water is likely to be used for industrial purposes. Total lignite coal reserves within IWC's intended service area are estimated at 4370 million tons (1). It is further estimated that by the year 2000, up to 130 million tons per year of coal will be utilized in the conversion to various forms of energy. Figure I-2 shows known lignite reserves in relation to the YDP intended service area. Within this area, it was estimated that development of energy reserves would require 30,000 ac-ft/yr of water by 1990, and that by the year 2000, development of these same energy reserves will require substantially more water per year than will be developed by the YDP alone (3).

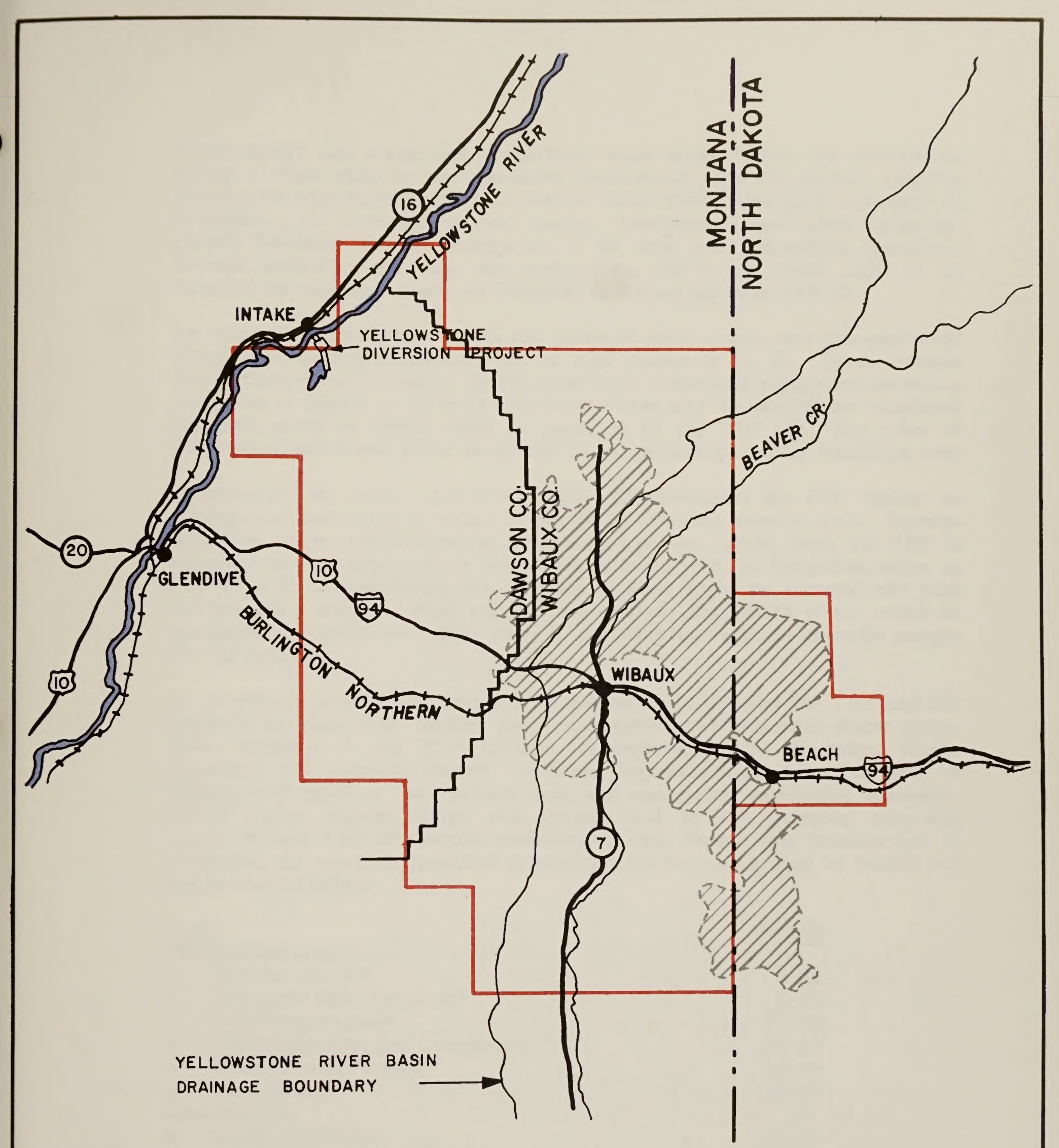


YELLOWSTONE DIVERSION PROJECT

Figure I-1

PROJECT LOCATION MAP





YELLOWSTONE DIVERSION PROJECT

Figure I-2

INTAKE WATER COMPANY
SERVICE AREA

5 0 5

SCALE IN MILES

These energy and water use projections were made during the mid-1970's, during a time when it was generally anticipated that the synfuel industry would grow significantly in the Northern Great Plains area (and especially in Montana). As time has shown, synfuel development and other industrial growth has been and is anticipated to be slow and controlled; therefore, current estimates are that the demand for IWC's full water right in its intended service area would not materialize before the year 2000 (2).

An increase in population within the intended service area was also projected based upon industrial development of coal resources (1, 2). Given certain assumptions about industrial development and consequent population growth, a maximum of 10,400 ac-ft/yr of additional water may be needed for municipal purposes, some of which could be provided by the YDP (2). The price of YDP-developed water would be within the range anticipated for municipal use.

In addition, the water marketing study (2) completed for IWC looked at agricultural marketing of water within IWC's intended service area. Surveys indicated there was interest in irrigation; however, water from the YDP is expected to cost substantially more than is being paid for irrigation water at this time. Even considering the increase in what might be economically paid for irrigation water at 1980 prices, it is unlikely that much water could be purchased for irrigation unless there is a substantial increase in profit margin for the irrigator.

As previously mentioned, time will be necessary to develop the YDP and the capacity to meet firm annual yield requirements of potential water users. Basic features of the YDP include construction of the diversion, intake screening and pumping system facilities, approximately 2.2 miles (mi) of underground pipeline, an earthen dam and associated regulating reservoir, outlet works, access bridge and gravel road to the pumping site and approximately 4 mi of electric transmission line. Permitting, construction of facilities, and start-up operation schedules have been identified by month and are presented below:

Task	Month
Pre-Construction	
o Site Inventory*	0-36
o Alternate Site Decisions*	0-36
o EAR Preparation+	02-38
o EIS Preparation and Completion	39-65
o Construction Permits	65-75
o Final Design	65-89
Construction	
o Lands and Rights	06-89
o Storage Reservoir Clearing and Dam Construction	89-115
o Diversion Structure	92-115
o Pumps and Motors	94-115
o Transmission Line	98-115
o Pipelines	98-115

Operation

o	Filling	116-119
o	Operation and Maintenance	120 to Project End

*Items Completed as of 12/80
+Completed 2/81

As indicated by this project schedule, service from the YDP is not anticipated until the late 1980's. This schedule is consistent with meeting the projected growth of IWC's intended service area.

C. LEGISLATION RELATING TO THE YDP

1. Water Rights Legislation

IWC proposes to divert up to 80,650 ac-ft/yr of water from the lower Yellowstone River pursuant to its appropriation, which is evidenced by the Notice of Water Right Appropriation for Filing of IWC dated 8 June 1973 (the Notice of Appropriation), which was filed on record as Document No. 319655, and recorded in Book D5 of Water Rights, on page 255 thereof, of the records of the Clerk and Recorder for Dawson County, Montana, at Glendive, Montana, on 8 June 1973, at 10:45 a.m.

Montana state water law in effect at the time of this appropriation (referred to as the Pre-Permit System) dated back to 1885, four years before Montana became a state. On 23 March 1973 the state legislature passed the "Montana Water Use Act" (referred to as the Permit System) regulating the use of waters existing within the borders of Montana pursuant to Article IX of the Montana Constitution ratified 6 June 1972.

Soon after the effective date of the Act (1 July 1973), the Montana Department of Natural Resources and Conservation (DNRC) sought to enjoin IWC from exercising its appropriated water right. However, in Montana Department of Natural Resources and Conservation v. IWC, 171 Mont. 416, 558 P.2d 1110 (1976), the Supreme Court of the State of Montana, which was called upon to consider the lower court decision concerning this appropriation, held, among other things, that ". . . IWC is the owner of an 'existing right' as that term is defined in the Montana Water Use Act of 1973 and the Montana Administrative Code for the reasons and under the authority of General Ag. Corp. v. Moore, 161 Mont. 510, 634 P.2d 859. . ." 558 P.2d 1110 at 1118.

It then held ". . . that there is nothing illegal, inequitable or contrary to public policy so as to preclude Intake from claiming a right to appropriate 80,650 ac-ft per year of the waters of the Yellowstone River. Intake has an existing right for the reasons and under the authority cited. . ." 558 P.2d 1110 at 1122.

This appropriation is unique in that the water right, as decreed by the lower court and upheld by the supreme court of Montana, "is for sale, rent, and distribution for irrigation, municipal, domestic, or industrial uses and for each of such purposes..." which is recognized under the 1889 and 1972 State of Montana constitution as a beneficial use.

The following sections review Montana water law as it existed under the Pre-Permit System and how it presently exists with the passage of the "Montana Water Use Act" (the Permit System). In addition, the Yellowstone River Compact and other legislation related to project development are also reviewed.

a. Pre-Permit System

The water laws of the State of Montana in effect at the time of IWC's notice of appropriation dated back to 1885 when the Legislative Assembly of the Territory of Montana recognized the need to make future water rights definite, and publicly documented. It further defined the right as "between appropriators the one first in time is first in right" (4). It enacted a statute that provided, among other things, that anyone desiring to appropriate the waters of non-adjudicated streams "must post a notice . . . at the intended point of diversion" and "shall file with the county clerk" a notice of appropriation describing the right to be acquired.

The Pre-Permit System (4) allowed the use of any unappropriated water of any source providing the appropriation was for some useful or beneficial purpose, and furthermore, it did not set limits on the amount of the appropriation; however, prior rights could not be impaired.

b. Permit System - "Montana Water Use Act"

On 6 June 1972, the people of the State of Montana ratified a new constitution in which Article IX, Section 3(4) required the state legislature to provide for the administration, control and regulation of water rights, and establish a system of centralized records of all water rights.

The legislature enacted the "Montana Water Use Act" on 23 March 1973 (effective 1 July 1973), for the purpose of implementing Article IX, Section 3(4) of the constitution. Because IWC's notice of appropriation was made prior to the effective date of the act, it is entitled to protection under the laws as they existed prior to 1 July 1973.

c. Yellowstone River Compact

The States of Montana, North Dakota, and Wyoming signed the Yellowstone River Compact as authorized under an act of United States Congress approved 2 June 1949. The Yellowstone River Compact effectively imposes restrictions on the YDP through limitations of interbasin transfers of IWC's water right. However, this restriction is not necessarily permanent, and can be removed through consent of the compact states. IWC currently has a petition pending before the Federal District Court challenging the validity of Article X of the Compact. Any further discussion of the Yellowstone River Compact is beyond the scope of this EIS because the Compact is extremely complex and will require interpretation by the courts.

2. Other Legislation

The Montana Major Facility Siting Act requires that a Certificate of Environmental Compatability and Public Need be issued by the Board of Natural Resources and Conservation as a condition to the construction of facilities for energy development and related projects (e.g., generation or transportation of electricity, gas or liquid hydrocarbon; transportation of water; conversion of coal; enrichment of uranium; in situ coal gasification; etc.). The YDP, as determined by the District Court of the State of Montana, is not considered a "facility" or "associated facilities" as defined by the Act. Furthermore, the judgment declared that "IWC is not required to obtain a Certificate of Environmental Compatibility and Public Need (for the YDP). . . under the provisions of the Montana Major Facility Siting Act." (No. 36907) It is likely that subsequent use of water sold by the YDP would be subject to either the Montana Major Facilities Siting Act and/or NEPA and would, therefore, undergo detailed environmental analysis before uses are approved.

II. ALTERNATIVES CONSIDERED -- INCLUDING THE PROPOSED ACTION

NEPA regulations (40 CFR 1502.14) require review and disclosure of all reasonable alternatives to the proposed action and the "No Action" alternative. It requires that these alternatives be rigorously explored and objectively evaluated. The NEPA process also requires the identification of alternatives eliminated from detailed study and the logic for selection of a preferred alternative.

To satisfy YDP objectives during initial planning phases, a number of preliminary project options (alternatives) were considered. As initial studies were completed, the various alternatives were either eliminated or carried into further study. Each determination was made in light of information available at the time. Evaluations of preliminary project options were completed at the point of filing the notice of appropriation for water. At this time, a project description had been drawn and three viable alternatives to this description were carried into detailed study. From these studies, a preferred alternative has been selected.

Alternatives presented in this chapter include the evaluation of no action, preliminary project alternatives, and detailed analysis of three alternative reservoir locations.

A. NO ACTION

The "No Action" alternative, which would preclude project development, may either be taken by IWC or the federal agency involved. Should the agency implement this alternative, requested permits would be denied, land uses of the project area are likely to remain the same, and development of area energy resources are anticipated to continue. Using the analysis contained within this document, the decision to select either the "No Action" alternative or preferred alternative can be made.

B. PRELIMINARY ALTERNATIVES CONSIDERED

Preliminary project alternatives which were examined included water resources available to the project and potential points of diversion on the Yellowstone River. Water resources eliminated from detailed study included groundwater and surface waters other than the Yellowstone. These were eliminated primarily because of:

1) inadequate supply of a firm annual yield;
2) unreliable water quality;
3) environmental impact with associated project development; and
4) costs of associated project development.

The area of the lower Yellowstone River proximal to the intended service area was examined for a potential point of diversion. The point on Joe's Island was selected for the following reasons:

1) consistent water elevations;
2) channel morphology conducive for intake construction;
3) proximity to intended service area;

4) proximity to reservoir storage sites; and
5) overall project costs.

IWC determined that a firm annual yield water supply of approximately 80,000 ac-ft/yr would meet projected needs of the intended service area. The following decision criteria were developed to determine the most suitable water source.

1) availablity -- ample quantities of water (approximately 80,000 ac-ft/yr) must be available for appropriation;

2) dependability -- the source must provide the quantity desired on a firm annual basis; and

3) quality -- the source must provide good quality water suitable for industrial, municipal and agricultural use with limited treatment.

The alternative water sources examined by IWC are described below.

1. Groundwater

The area of the YDP is underlain by four major water bearing zones. While shallow alluvial aquifers are limited to the valleys of the Yellowstone River and its tributaries, deep aquifers (including sandstones and coals in the Fort Union Formation, sandstones in both the Fox Hills and Hell Creek formations, and limestones in the Madison Group) underlie much of the basin. The Fort Union and the Fox Hills-Hell Creek formations are important for providing small amounts of water for stock and domestic use. The highest potential for development is found in the shallow alluvial systems and the limestones in the Madison Group. These aquifers are capable of producing from very little to 6000 ac-ft/yr. Quantity and quality of the groundwater from these aquifers are extremely variable, and often times poor (5, 6, 7).

Groundwater, as a supply source, was eliminated as an alternative because:

a. estimated flow rates were not sufficient to provide an annual withdrawal of approximately 80,000 ac-ft/yr without installation of numerous well fields and a collection pipeline system. Associated costs make this alternative unfeasible;

b. long term, large scale withdrawals could lead to substantial drawdown of groundwater levels. This has been demonstrated by an ongoing secondary oil recovery operation occurring in the adjacent counties of Prairie, Fallon and Wibaux. The recovery operation caused numerous area wells to run dry following several years of withdrawing approximately 1800 ac-ft/yr of water from the Fox Hills and basal part of the Hell Creek Formation aquifer (8); and

c. water quality varies both from formation to formation and within each formation (up to 300,000 mg/l total dissolved solids) (9).

2. Surface Water

a. Tributary Streams

Tributary streams of the Yellowstone River and other surface water resources proximal to the intended service area were examined. Stream gaging records and water appropriations were reviewed to assess the availability of water on a firm annual yield basis in the amounts needed for the project. The resources examined included the Bighorn River, Powder River, Tongue River, and other smaller streams of the area. In addition, IWC filed an Application for a Beneficial Water Use Permit on 3 May 1973, to develop the waters of Beaver Creek by means of an onstream dam. However, due to the intermittent flow of Beaver Creek, the firm annual yield of this project is so low that it offers only supplemental supply. At best, the Beaver Creek Project can only supply 6800 ac-ft/yr.

Detailed review of stream gaging records and other information of the area revealed that flow within these streams fluctuated widely from season to season and year to year. In addition, senior water appropriations would impose restrictions on withdrawal during low flow periods which are common during major portions of the year. As a result, tributary streams were eliminated from further detailed study because none were determined to be capable of producing reliable sustained flows which would provide adequate firm annual yield water supplies in the quantity desired.

b. Yellowstone River

Preliminary studies indicated that the Yellowstone River was discharging approximately 8.8 million ac-ft/yr of water on an average annual basis at the Montana-North Dakota border and ample quantities of this flow were available for an appropriation that could meet IWC's anticipated needs. Examination of flow records indicated that the Yellowstone is dependable in annual yields. However, due to seasonal fluctuations and existing prior rights, it would have been impossible to provide firm daily yield over the period of record studied.

With the identification of a water source, additional project criteria were added. These include:

1) backwater conditions at the diversion point -- consistent water elevations must be present at the point of diversion to allow for a reliable diversion during low flow periods;

2) proximity to potential reservoir storage sites -- as no existing surface water source could supply constant firm yields, construction of a storage facility would be necessary; the point of diversion must be in close proximity to potential storage sites to minimize costs and environmental impacts associated with pumping and pipeline construction; and

3) land availability -- land must be available to access and construct the facilities required to develop the project.

An initial survey of backwater areas in the vicinity of intended service area identified the Lower Yellowstone Irrigation District's (LYID) dam near Intake, Montana, as the best point to satisfy all design criteria. A detailed study conducted in April 1973 examined cross-sections of the Yellowstone River and determined that the most suitable point of diversion was approximately 4000 ft upstream of the LYID dam. This point exhibited consistent water elevations which would provide a reliable diversion during low flow conditions as well as a channel morphology which would be appropriate for construction of the intake structure. An additional survey indicated that topography of adjacent lands would lend itself to potential reservoir storage sites.

It was apparent that this intake location met the project design criteria; therefore, on 8 June 1973, IWC posted its Notice of Appropriation, as required by existing Montana statutes. This notice specified IWC was appropriating (for a beneficial use) 80,650 ac-ft/yr of water from the Yellowstone River at the specified point of diversion located on Joe's Island. As previously mentioned, this appropriation was upheld in 1976 by the Montana Supreme Court and development of this right and associated conveyance facilities has since proceeded with due diligence.

C. ALTERNATIVE RESERVOIR LOCATIONS

With an established water right and point of diversion, IWC identified alternative reservoir locations which:

1) were morphologically and topographically capable of storing approximately 25,000 ac-ft of water;

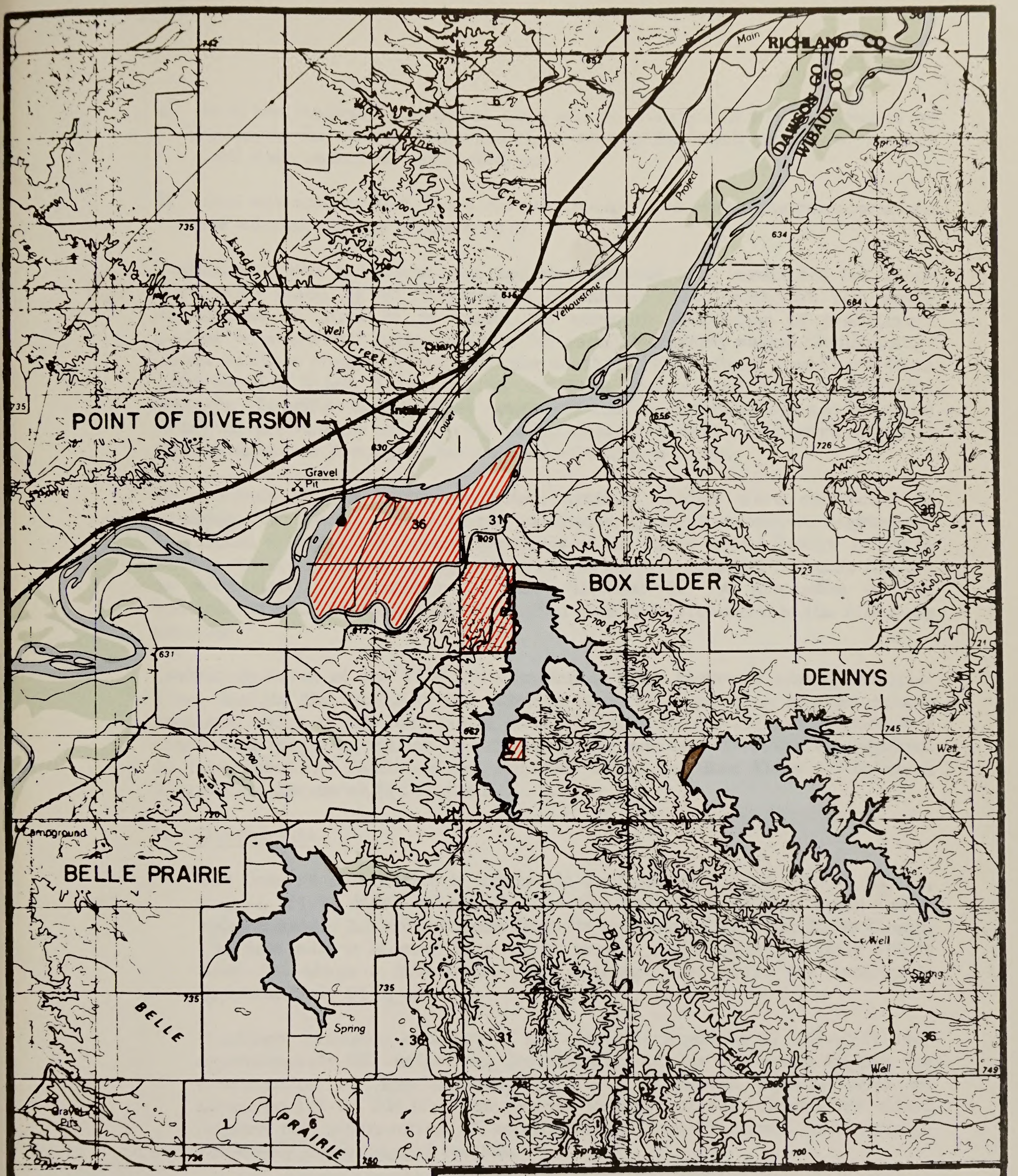
2) were an acceptable pumping distance from the point of diversion on the Yellowstone River;

3) were potentially available for purchase or lease; and

4) were environmentally compatible with surrounding land uses.

Initial siting studies revealed three potential sites within the Box Elder Creek drainage (Denny's, Belle Prairie, and Box Elder). The spatial relationships of the three alternative reservoir sites to the point of diversion are shown in Figure II-1. These investigations determined :

1) that each site appeared geologically capable of water storage. Although foundation conditions and construction materials were not examined during this study, no evidence was found of geologic conditions that would adversely impact construction or operation of dams and reservoirs at these sites;



YELLOWSTONE DIVERSION PROJECT

Figure II-1

ALTERNATIVE RESERVOIR LOCATIONS

SCALE MILES 1 0 1

2) that the majority of land at each site is private and was believed to be available for sale or lease and right-of-way for small parcels of federal land were potentially available; and

3) that environmentally, there did not appear to be overriding considerations for eliminating any of these sites.

Preliminary site reconnaissance and development cost estimates for these sites were made by an independent consultant (10). Although this study determined all sites to be viable, an economic evaluation of preliminary designs revealed that cost estimates for each alternative varied significantly. Based on these studies, annual cost per ac-ft (in 1980 dollars) would be $100 to $400 for Box Elder, $184 to $736 for Belle Prairie, and $200 to $800 for Denny's. In addition, this study concluded that selection should not be based solely on preliminary engineering design costs, but that other environmental studies should be completed before final selection is made.

As a result of this recommendation, detailed studies were conducted to examine site-specific geotechnical conditions, cultural resources, vegetation, terrestrial wildlife, and aquatic resources of the three sites. Results of these studies were considered along with engineering and construction cost factors to determine the feasibility of each alternative. A discussion of the conclusions reached during these detailed studies is presented in the following sections.

Several features of the YDP are common to each reservoir site alternative. These include the diversion and pumping structures, pumping regime, access road and bridge to the Joe's Island point of diversion, and the transmission line connecting the pump station to existing power sources. Detailed descriptions of these common facilities are included under the Box Elder - Preferred Alternative discussion in Section II. C. 3.

1. Denny's Site

The Denny's Alternative is located in Sections 10, 11, 14, 15, 16, 22, 23, and 24, T17N, R55E (Figure II-1) in the East Fork of Box Elder Creek approximately 2.5 mi upstream from its confluence with Box Elder Creek. The dam site is located in a steep, rugged valley approximately 300 ft deep and about a mile wide. The drainage area above the damsite is approximately 11 sq mi.

Maximum available capacity of the reservoir would be 27,130 ac-ft over approximately 600 surface ac. Development of this site would require the construction of approximately 30,000 ft of buried pipeline with an elevation lift of 204 ft. The remote location of this alternative would require the construction of approximately 2 mi of access road through extremely steep, rugged terrain.

This alternative was eliminated from detailed study because:

1) the 1975 preliminary site investigation and economic evaluations of the facilities indicated that the Denny's site would develop water at the highest cost of all three alternatives;

2) construction of 2 mi of access road through steep, rugged terrain would contribute to environmental impacts. Such construction may increase the significance of impacts associated with destruction of existing vegetation and wildlife habitat, accelerated soil erosion, and increased fugitive dust; and

3) cultural resource investigations (11) identified areas of cultural value in and around this reservoir site.

2. Belle Prairie

The Belle Prairie Alternative is located approximately 4 mi south of the Yellowstone River diversion site on an unnamed tributary of Box Elder Creek in Sections 22, 23, 26, 27, 34, and 35, T17N, R56E (Figure II-1).

Detailed geotechnical site investigations conducted in 1979 (12) revealed significant variation in underground conditions from what had been anticipated. These investigations revealed that alluvial soils more than 80 ft thick were located beneath the dam axis and reservoir site. These conditions would allow excessive rates of seepage loss beneath the dam and around the reservoir. Therefore, this alternative is considered unfeasible.

3. Box Elder - Preferred Alternative

The Box Elder Preferred Alternative is designed to utilize IWC's existing appropriation of 80,650 ac-ft/yr of water from the lower Yellowstone River. This would be accomplished by pumping water from the diversion site to an offstream regulating reservoir in the Box Elder Creek drainage, approximately 2.2 mi from the diversion site (Figure II-2). An intake and pumping structure would be located on Joe's Island at the point of diversion, approximately 4000 ft above the existing Lower Yellowstone Irrigation District's (LYID) irrigation diversion dam. Aproximately 11,700 ft of pipeline would connect the pump station to the reservoir. All water sold by this project would pass from the reservoir outlet works to a pipeline provided by the water user.

Basic features include:

1) an offstream regulating reservoir of approximately 750 surface ac with a normal high water capacity of 25,000 ac-ft;

2) a 2300-ft long, 100-ft high zoned earthen dam with cutoff trench across Box Elder Creek Canyon;

3) diversion and pumping structures on the south bank of the Yellowstone River, capable of pumping a maximum of 200 cubic feet per second (cfs), not to exceed 111.4 cfs on an average annual basis;

4) approximately 11,700 ft of pipeline from the pump station to the reservoir;

Intake

MAIN CANAL

NORTHERN P.S.B.R.

TRANSMISSION CORRIDOR

BM 2015

TRAIL

RIVER

YELLOWSTONE

Gravel Pit

PUMP STATION (POINT OF DIVERSION)

PIPELINE / TRANSMISSION CORRIDOR AND ACCESS ROAD

Box Elder Creek

Box Elder Creek

Box Elder Creek

ROAD

PRAIRIE

T 18 N

T 17 N

R. 56 E.

R. 57 E.

SCALE IN FEET

1000 500 0 1000 2000

INTAKE WATER CO.

HOUSTON, TEXAS

YELLOWSTONE DIVERSION PROJECT

FIGURE II-2

BOX ELDER PREFERRED ALTERNATIVE—GENERAL PLAN

AREA OF DISTURBANCE

TENNECO

5) construction of a bridge and an all-weather road to provide access to the Joe's Island pump station structures; and

6) a transmission line of approximately 4 mi connecting the pump station and reservoir outlet works to an existing transmission line on the north side of the river.

A detailed description of each of these project components is presented below.

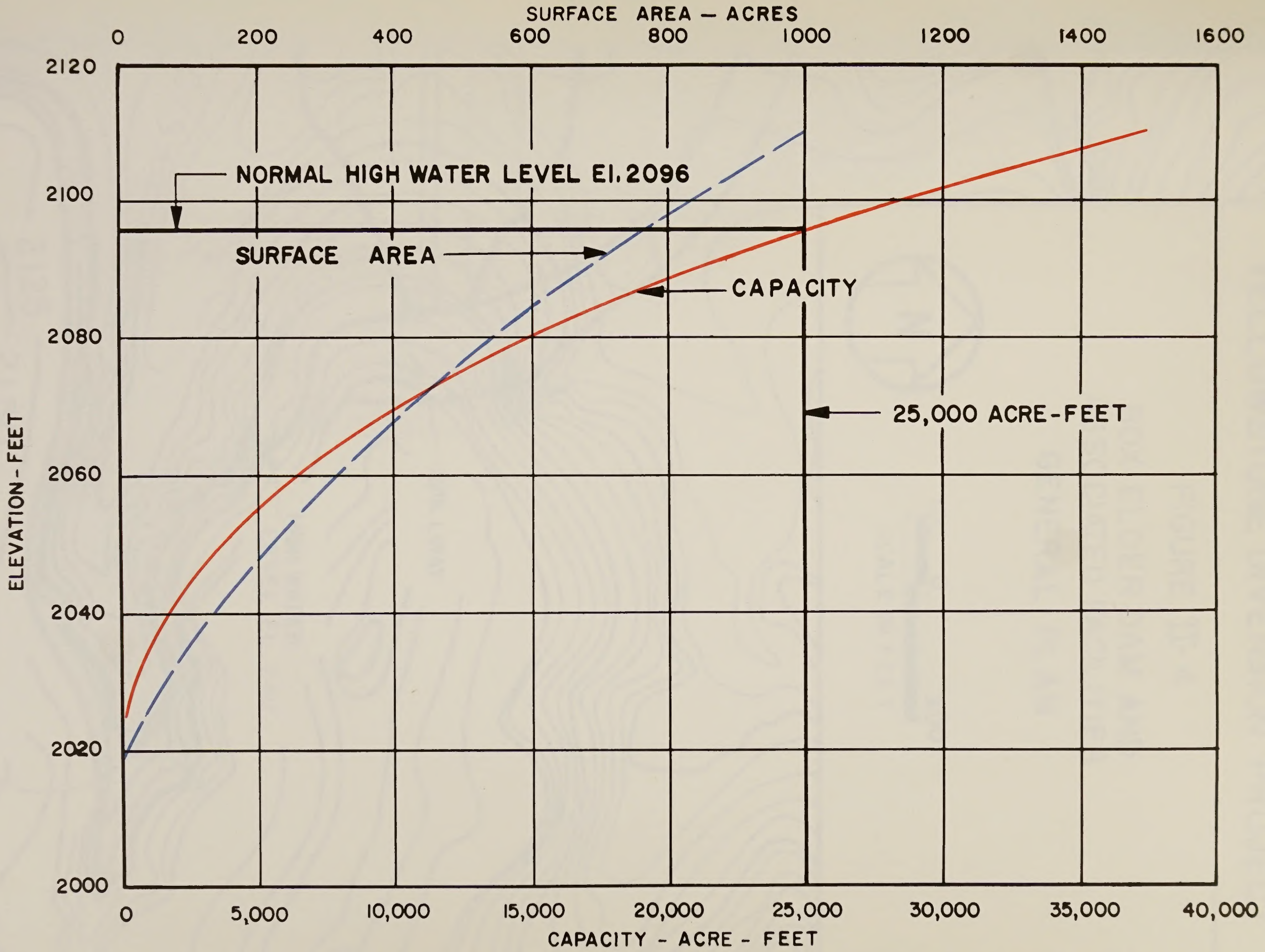
a. Box Elder Dam and Storage Reservoir Site

The dam and storage reservoir would be sited at the lower end of Box Elder Creek in Sections 5, 6, 7, 8, 9, and 18, R57E, T17N (Figure II-1). The drainage area above the dam site is approximately 140 sq mi. The reservoir would hold approximately 25,000 ac-ft of water when full and would have a normal high water surface elevation of 2096 ft mean sea level (msl). Preliminary design assumes the dam crest to be at 2115 ft msl to provide 19 ft of freeboard for wave containment during the design flood. The reservoir would fluctuate between the maximum operating pool of 750 surface ac (except during flood periods) and a minimum pool of approximately 50 surface ac (2040 ft msl, holding 500 ac-ft). The reservoir area capacity curve is presented in Figure II-3. Periods of maximum drawdown would result in 700 exposed surface ac.

Within the reservoir site, trees and all other vegetative material and debris would be chained into piles and burned. With the exception of localized areas where unstable high wall conditions exist on the reservoir perimeter, present contour of the site would not be disturbed. Construction staging and borrow areas for the dam would include approximately 1000 ft above and below the dam axis (Figure II-4). Areas of disturbance would include approximately 67 ac for construction staging on the west abutment and north of the dam.

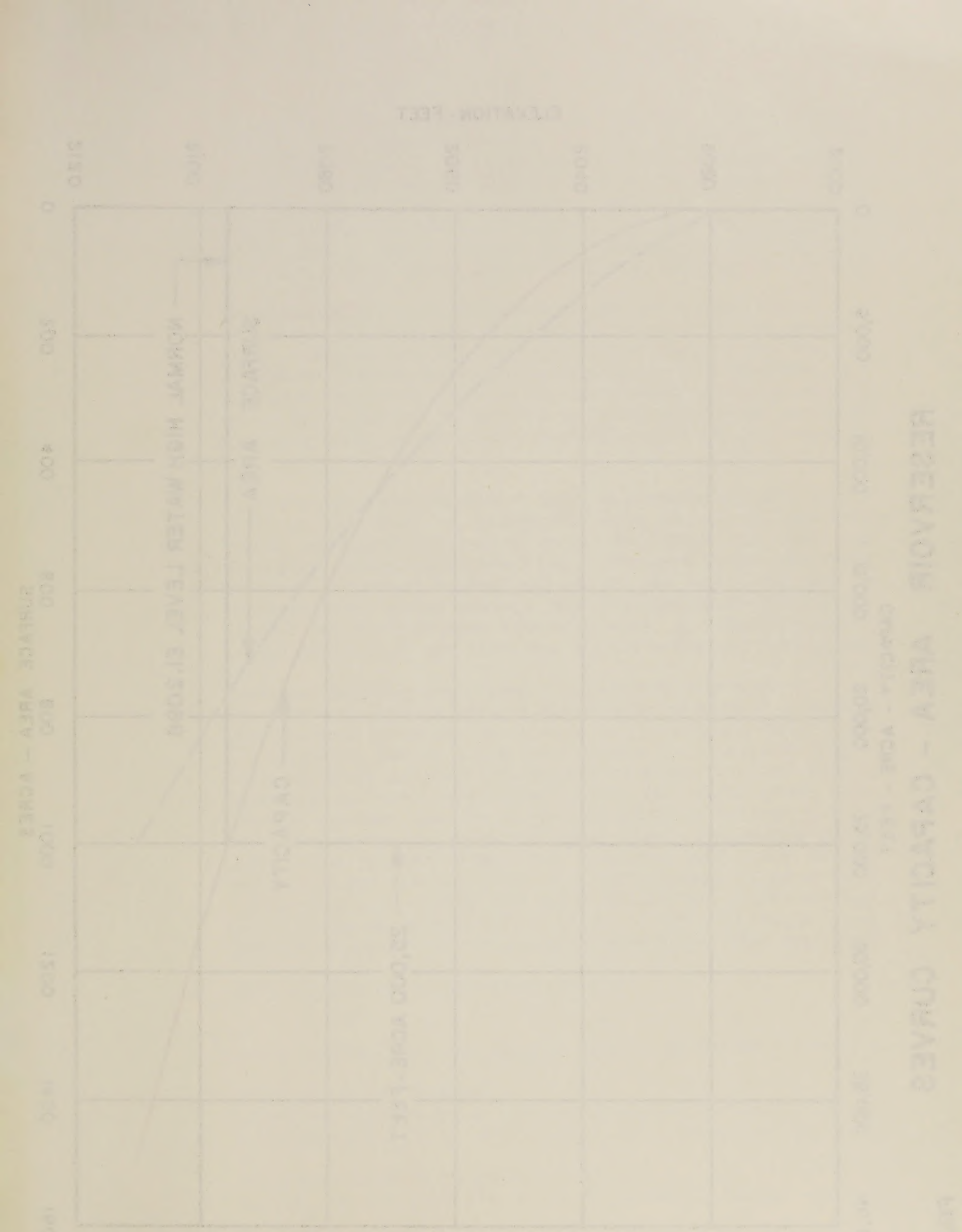
Facilities would be constructed primarily during the dry periods of the year. However, a diversion of Box Elder Creek would be necessary while construction of the cutoff trench and outlet works is in progress. Natural flow of Box Elder Creek was not considered as a supply source for the reservoir. The natural incoming flow would be measured by gaging stations installed upstream of the proposed reservoir, and flow would be passed through the reservoir outlet.

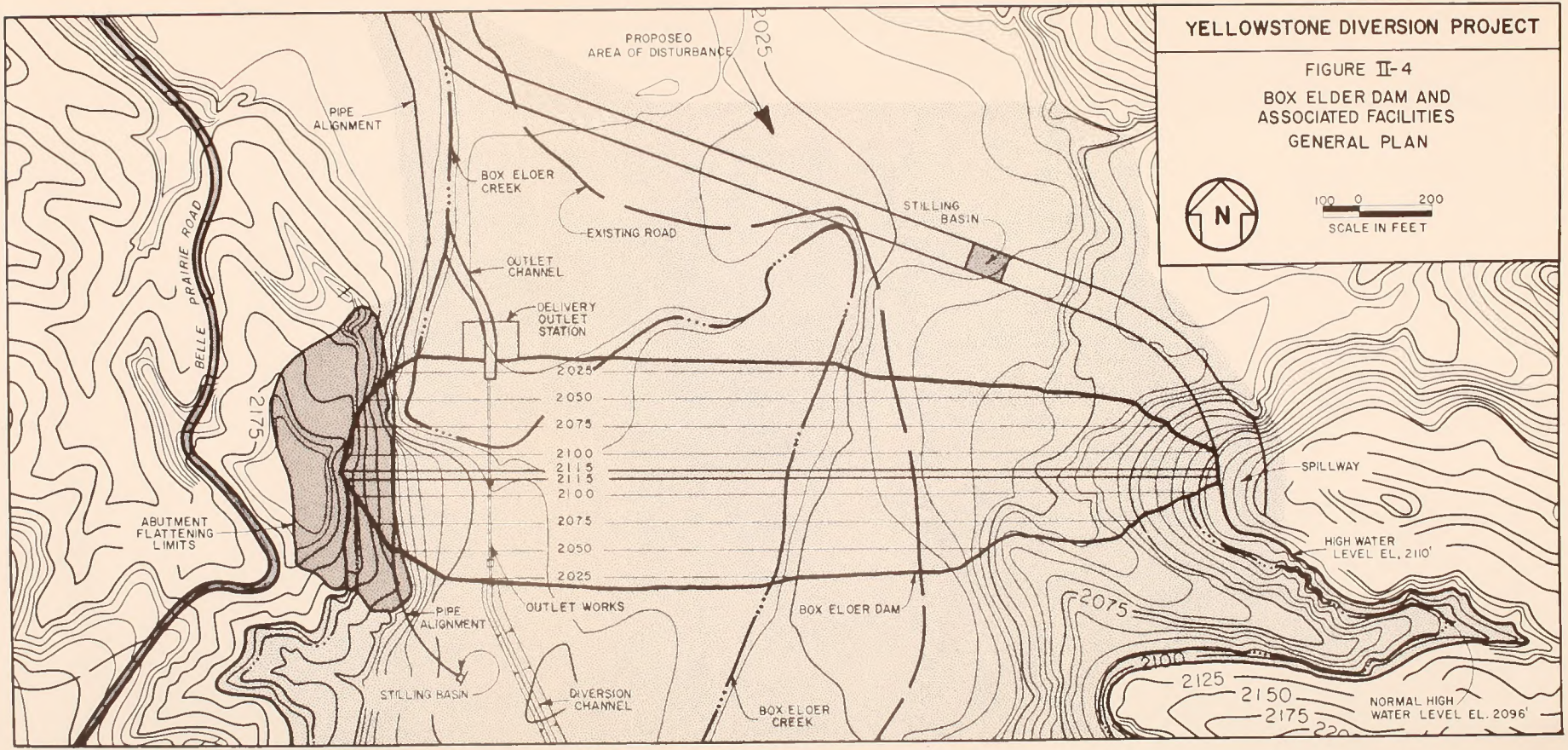
The 2300-ft long, 100-ft high earthen dam embankment would be constructed of zoned material which would include a relatively impervious core to minimize seepage. The upstream embankment would consist of riprap or soil cement facing and would be used to provide protection from wave action. Preliminary estimates indicate that approximately 670,000 cubic yards (cu yds) of material would be needed for the impervious central core and cutoff, 1,510,000 cu yds of materials for upstream embankments, 80,000 cu yds of material

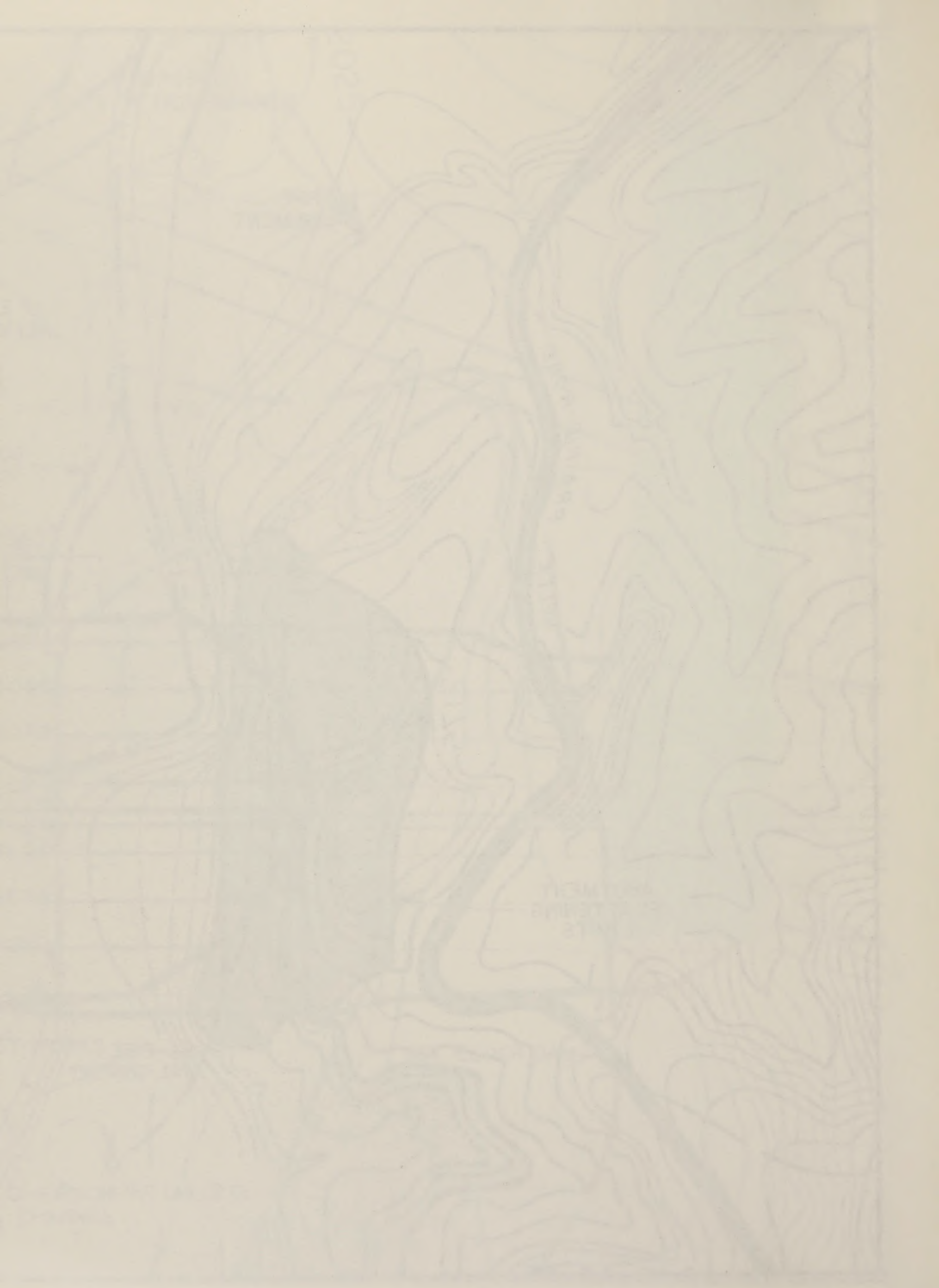


RESERVOIR AREA - CAPACITY CURVES

FIGURE II-3




YELLOWSTONE DIVERSION PROJECT
FIGURE II-4
BOX ELDER DAM AND ASSOCIATED FACILITIES
GENERAL PLAN
N
100 0 200
SCALE IN FEET
PROPOSED AREA OF DISTURBANCE
PIPE ALIGNMENT
BOX ELDER CREEK
EXISTING ROAD
STILLING BASIN
OUTLET CHANNEL
DELIVERY OUTLET STATION
BELLE PRAIRIE ROAD
2025
2050
2075
2100
2115
2175
ABUTMENT FLATTENING LIMITS
SPILLWAY
HIGH WATER LEVEL EL. 2110'
OUTLET WORKS
BOX ELDER DAM
PIPE ALIGNMENT
STILLING BASIN
DIVERSION CHANNEL
BOX ELDER CREEK
2125
2150
2175
NORMAL HIGH WATER LEVEL EL. 2096'



for blanket and chimney drains, and 63,000 cu yds of riprap or 53,000 cu yds of soil-cement for slope protection of exposed areas. The dam, a Soil Conservation Service Class B structure, would be designed to pass one-half of the probable maximum flood, and would meet the USCE safety standards.

Recommended seepage reduction measures for the dam include a full depth compacted earth cutoff, grouting to reduce bedrock seepage around the abutments, and a clay blanket connected to a soil-cement abutment lining extending about 500 ft upstream of the dam (13).

Several spillway designs are under consideration at this time. However, an open channel spillway located on the right abutment has been recommended (13). Spillway designs incorporate a broad crested weir, spillway chute, stilling basin and spillway channel (Figure II-4).

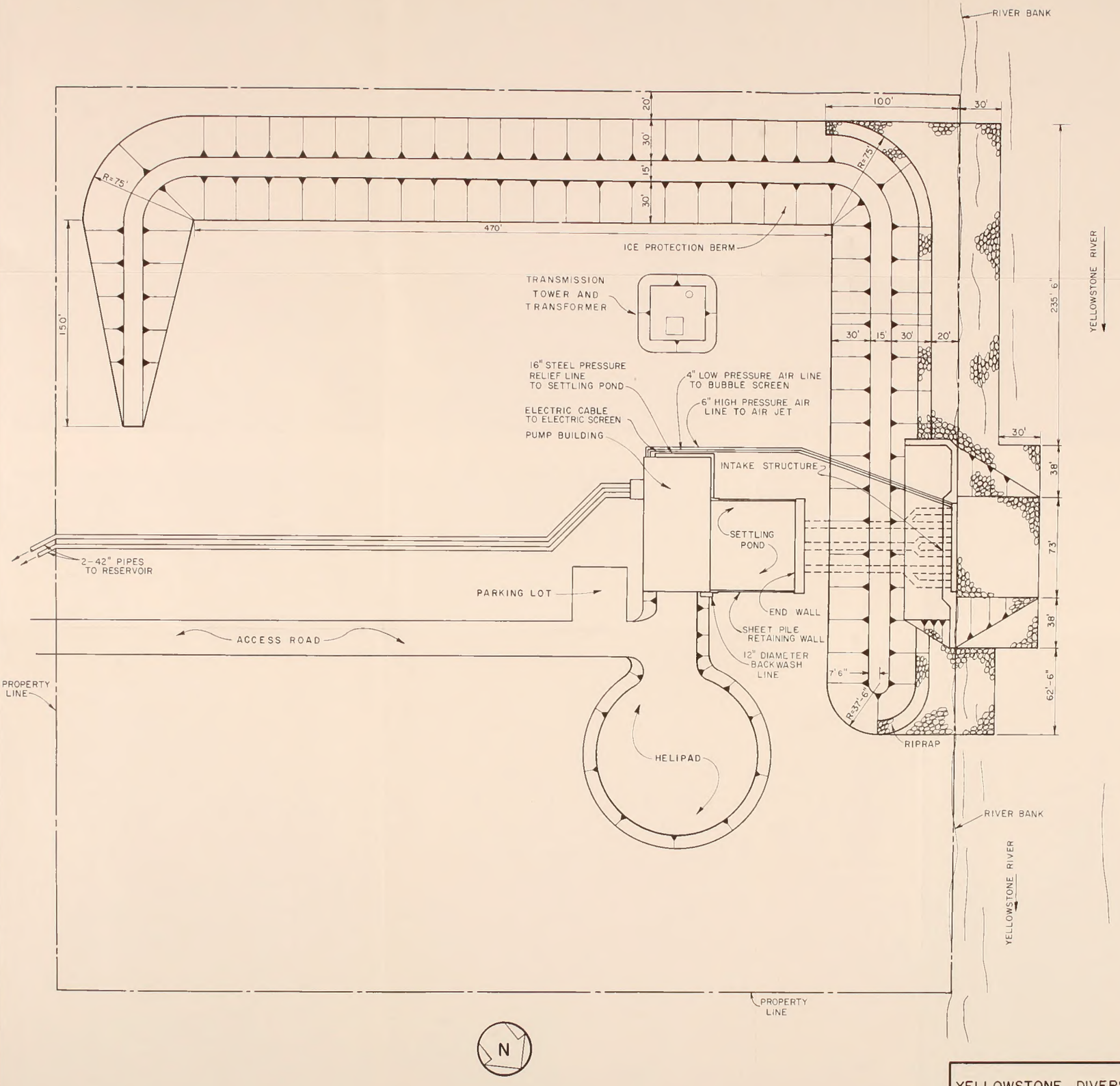
It is envisioned that the outlet works would satisfy three basic needs. First, it would provide a conduit through which diversion flows of Box Elder Creek would be passed during dam construction and operation. Second, it would be used to pass flows to the pump station and eventual users. Third, the outlet works could be used to draw the reservoir level down in the event of an emergency. The outlet works would be located below the dam on a 10-ac site (Figure II-4).

b. Pump Station Site

The point of diversion, intake, and pumping station would be situated on a 10-ac tract on Joe's Island (Figure II-5). The two basic components of this system are: 1) diversion and intake structures with associated screening, and 2) sump and pump station structures. Preliminary design indicates the 10-ac tract would be totally disturbed by construction of these facilities. The area would be fenced to prevent domestic livestock from entering the site.

A compacted earthen and riprap berm would be constructed along the south, west, and east sides of the site (Figure II-5). This berm would be approximately 15 ft high containing 25,000 cu yds of material. Its purpose would be to serve as a protective barrier for the pumping facilities against ice which periodically moves across the site during the spring breakup of the Yellowstone River. Final engineering design may utilize a complete earthen pad upon which the pumping facilities may be constructed. Estimates of dimensions or materials required for this alternative have not been calculated.

Construction of the diversion structure would include a temporary coffer dam to provide working space on the river bank. The dam would include an area 60 ft wide and 150 ft long (Figure II-5) and would be constructed of sheet-steel driven into the river bottom. The area would be dewatered with portable pumps exposing the bank area for intake structure construction. This work would be done during low flow periods and is anticipated to take approximately four months. The material removed for construction of the intake



YELLOWSTONE DIVERSION PROJECT

FIGURE II-5

PUMP STATION and DIVERSION FACILITIES
GENERAL PLAN

structure would include 2400 cu yds and be used as material for the berm. An estimated 6700 cu yds of riprap would be used as protective facing on the berm and intake structure. Upon completion, the sheet-steel coffer dam would be removed.

The intake design includes a concrete headwall intake structure located on the edge of the Yellowstone River. Water would enter the intake through a rectangular opening at the base of the structure. Elevation of this opening is based on river cross section studies conducted during 1981 (14). The opening would be protected from large floating and submerged objects by a trash rack equipped with a mechanical rake for cleaning. Final design of the intake and screening systems would utilize state-of-the-art technology to minimize entrapment and entrainment of fish, fish eggs, and larvae. Cooperation between IWC, United States Fish and Wildlife Service (USFWS), and Montana Department of Fish, Wildlife, and Parks (MDFWP) has determined that a design combining water jet streams, an air bubble curtain, and a mild field of electricity should minimize loss of fish from the river. The floating air jet system would be removed during those months when larval fish are not present in the river. Water entering the rectangular opening at the front of the intake structure would manifold into reinforced concrete pipes and pass into the settling pond. Flow velocities entering the intake structure at the river would range from 0.5 feet per second (fps) at a pumping rate of 200 cfs to 0.06 fps at a pumping rate of 25 cfs.

A settling pond was incorporated in the facilities design for removal of suspended sediment. The estimated 3800 cu yds that would be excavated to construct the pond would be used as fill for the berm.

The sump and pump station structures would be located approximately 40-60 ft inland from the diversion structure (Figure II-5). It is estimated that 4200 cu yds would be excavated for these structures and would be used as fill for the berm. Water would enter the pumping facility through openings in the sump wall. Screens would provide additional protection for adult fish which may pass through the fish screening devices located on the river at the intake structure.

A small gravel parking lot would be constructed in the 10-ac pump station site (Figure II-5).

c. Intake and Pump Equipment Design

It is envisioned that eight pumps would provide the desired pumping capacity range from 25 to 200 cfs. All pumps are planned to be single-speed turbine-type pumps. To obtain the 25 cfs minimum discharge, one 400-horsepower pump would be needed. The 200 cfs maximum flow would be obtained using four 400-horsepower pumps and four 900-horsepower pumps. Pump sizing was based on providing approximately 10 incremental discharge rates over the pumping range of 25 to 200 cfs.

Operation of the pumps would be controlled from two different locations, the control room at the pumping facility and a remote location to be established in Glendive. Pumps could be started manually from either site with automatic shutdown by devices which would sense a full reservoir, a fish screen failure, a low river level or a traveling screen failure. Flow through the system would be measured and recorded using a primary venturi flow element and a continuous recorder.

d. Right-of-way Sites

The YDP would require a number of support facilities which would utilize lands outside the pump station and reservoir sites. These requirements are discussed in the sections below.

(1) Pipeline

Water would be carried from the sump and pump station through two parallel 42-in diameter steel pipelines to the reservoir. No booster stations would be needed. A construction ROW of 150 ft along the pipeline route would be utilized and a 60-in trench would be dug for each pipeline along the 11,700 ft route (Figure II-2). Separation of the two trenches would be 25 ft with the exception of the side channel crossing where the trenches would be 50 ft apart. An additional staging/work area of 300 by 700 ft would be located on each side of the channel crossing. Total disturbed area of the pipeline route and staging area would be approximately 43 ac. Vertical rise along the pipeline would be approximately 20 ft along the pipeline route, plus another 100 ft over the dam.

The pipes would be placed below frost depth and encased in concrete at the crossing of the Yellowstone River side channel, Box Elder Creek, and the crossing of River and Belle Prairie Roads. The depth of burial and concrete casing would provide sufficient surcharge load to resist uplift pressure caused by bouyancy if the pipe is empty during periods of high water. The pipeline would be constructed across the side channel and Box Elder Creek during low flow periods. Construction would include clearing the 150-ft ROW, salvaging topsoil, digging the trenches, assembling and burying the pipe, replacing topsoil, and seeding the disturbed area. Seed mixtures would consist primarily of grasses as approved by the BR. A 100-ft operational ROW would be maintained throughout the life of the project and would include periodic mowing of vegetation to prevent tree and shrub growth in order to maintain the integrity of the pipe. The pipeline discharge point would be located a few hundred feet from the upstream toe of the dam in the reservoir (Figure II-4). A stilling basin would be provided to dissipate energy prior to discharge of flows into the reservoir.

(2) Site Access

A gravel all-weather road, together with a bridge across the side channel, would be constructed from River Road across Joe's Island to the intake and pump station location. This would be accomplished by constructing the access facilities adjacent to the pipeline (Figure II-2) utilizing approximate existing contour of the Island so as not to impede flood or ice flows. Upgrading the existing trail on the island for access was examined; however, potential impact from the possibility of ice jams excluded development of facilities at that location. Design of the bridge would incorporate a total span or single pillar support structure to prevent buildup of ice within the side channel.

Additional access to the pumping station would be provided by construction of a heli-pad which would allow operation and maintenance personnel to reach the site via helicopter during periods of high water and ice flows (Figure II-5).

Access to the dam and reservoir would be provided through existing roads or trails (Figure II-2).

(3) Transmission Line

Construction of a transmission line would be required to provide the electrical energy necessary for the intake, screening, and pumping equipment. A 60-kilovolt (kV) line and associated step-down facilities would be constructed from an existing line on the north side of the river (Figure II-2). The facilities would be constructed in two segments, one from the existing line to the pump station and the other from the pump station to the reservoir outlet works. The latter would follow the pipeline ROW.

On the north side of the river, the line would utilize a 30 ft ROW with disturbance occurring only at support structure locations. These would be single wood-pole structures spaced at intervals of 300 ft. Height of the poles would be 40 ft supporting the three-phased conductors which would be spaced a minimum of 90 in apart. In the area of the river crossing, a three wood-pole structure would be utilized on each side. Height of the poles would be 60 ft to compensate for the line sag over this 600 ft span. Conductors would be spaced 120 in apart. It has been determined by Montana-Dakota Utilities that burial of the transmission line across the Yellowstone River is not possible due to ice scowering of the river bottom; however, burial on Joe's Island is being considered.

On Joe's Island, the first structure would be located on a 15 ft high embankment. The embankment area would be 170 by 120 ft. Following this structure, two alternative transmission line designs are presently being considered. The first design would utilize overhead construction on 40 ft H-frame structures. Spacing of the structures and conductors would be 500 ft and

90 in, respectively. Ice protected fill areas of 30 ft in diameter and 15 ft high would be utilized to support the poles. A total of 15 of these fill areas would be necessary (5 from the river to the pump station and 10 from the pump station to the outlet works). The other design would utilize overhead construction to the pump station and burial of the conductor from the pump station and to the outlet works. A ROW of 50 ft would be necessary from the river to the pump station while the existing pipeline ROW would be utilized from the pump station to the reservoir.

e. Borrow Areas

Geotechnical investigations (13, 15) indicate that ample quantities of suitable borrow materials for dam construction are available in the area. Material for upstream and downstream layers can be acquired from the reservoir site. Drain materials, impervious central core material, and riprap may be quarried near the site.

Five potential sites for borrow material were identified near the proposed site during the 1982 geotechnical investigations (Figure II-6).

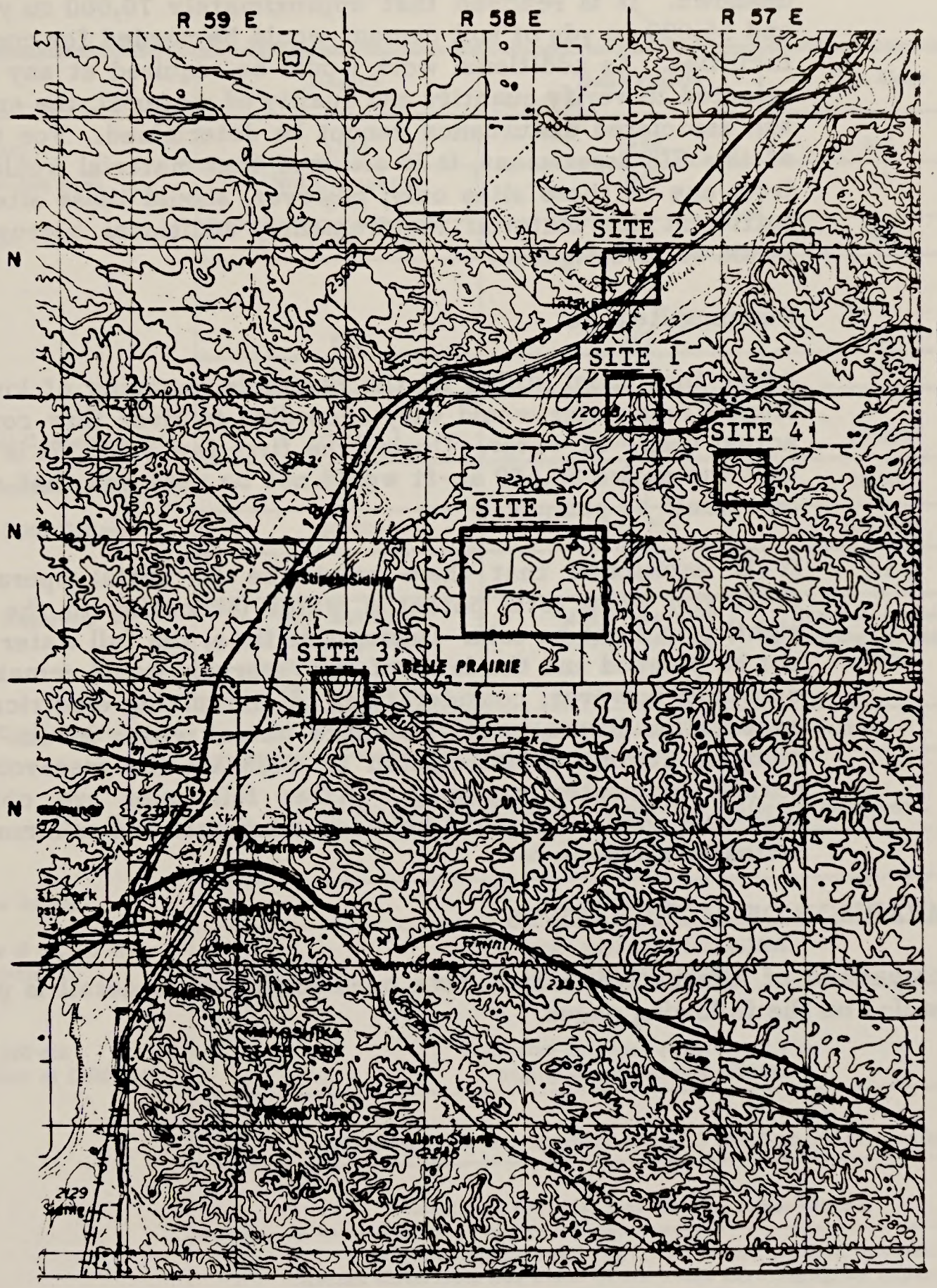
Site 1. Site Number 1 lies in Section 31, T18N, R57E. The proposed riprap source, a sandstone unit, lies along the bluff top. About 60,000 to 100,000 cu yds of rock appear to be available at this stie. It is estimated that about 120,000 cu yds of material would have to be excavated to obtain the required material.

Site 2. Site Number 2 is an existing sandstone quarry located on the north side of the Yellowstone River in Section 19, T18N, R57E, and Section 24, T18N, R56E. It is estimated that ample amounts of material are available for use as slope protection, although probably 150,000 to 200,000 cu yds of material may have to be removed to obtain the required amount.

Site 3. Site Number 3 lies in Section 4, T16N, R56E about 13 mi south of the proposed damsite. Sandstone was quarried from this location about 16 years ago by the Montana State Highway Department for use as riprap on bridge abutments in the Glendive area. No estimates were available on the quantity at the site; however, discussions with the landowner and the highway department indicate considerable quantities are still available.

Site 4. Site Number 4 lies approximately 1.5 mi southeast of the dam site in Section 9, T17N, R57E. No estimates of available material were made. However, the landowner indicated that the outcrop was of hard weather-resistant sandstone.

Site 5. Site Number 5 is located about 3 mi southwest of the Box Elder damsite in Sections 14, 15, 22, 23, 26, 27, T17N, R56E. This site would be utilized if additional soil cement other than that in the reservoir area is required. It appears that sufficient quantities of silty sands are available in this borrow area for soil cement.



GENERAL SITE LOCATIONS
SCALE 1:250,000

YELLOWSTONE DIVERSION PROJECT

FIG. II-6

BORROW AREA
SITE LOCATIONS

At the present time, the requirements for off-site materials are unknown. It is realized that approximately 70,000 cu yds of riprap and 55,000 cu yds of soil cement would be needed for construction of facilities. As additional work would be required at any of the sites selected to verify quantity and quality of material, the exact location and associated disturbance cannot be determined. For the purposes of this EIS assessment, it is assumed that material would be utilized from one of these sites only; however, should these sites not prove sufficient for material requirements, additional borrow area sites would be investigated.

f. Pumping Regime

After the initial filling of the reservoir, pumping of lower Yellowstone River water would vary according to river flow conditions and actual usage of water. During the first few years, it is quite likely that the entire 80,650 ac-ft would not be used and that considerably less would be pumped.

It is envisioned that there would be an initial operating period (0-20 yrs) when total potential water (according to the IWC water right) would not be sold. During this time, the full water right would not be pumped and the level of the reservoir would remain relatively constant; however, considerations of minimizing electrical costs and evaporation losses would influence actual water levels. An initial pumping regime is anticipated to maintain the reservoir at 3/4 of normal highwater capacity. After full sales are obtained, the reservoir would fluctuate between maximum and minimum levels as indicated above.

D. COMPARISON OF ALTERNATIVES

A comparison of alternatives which have been examined in detail is presented in Table II-1 on the following pages.

TABLE II-1

COMPARISON OF ALTERNATIVES

Potential Impact	Denny's	Belle Prairie	Box Elder	No Action
Affected Land Area (ac)	610*	685*	891	0
Mitigated/Revegetated Area	Not Calculated (NC)	NC	86	0
Net Acres Affected	NC	NC	805	0
Federal Lands				
BR	NC	NC	95	0
BLM	NC	NC	40	0
Approximate Reservoir Capacity (ac-ft)	27,100	20,500	25,000	0
Net Ac-ft Available for Sale (Annual)	78,000	78,000	78,000	0
Cost per Ac-ft Yield (1980 Dollars)	200-800	184-736	100-400	0
Pipeline Length (mi)	5.7	3.8	2.2	0
Site Accessibility - Reservoir	Most difficult: 2 mi of new road construction through rough terrain	Easy: accessed through existing road	Easiest: accessed through existing roads	No Impact(s) (NI)
- Diversion Point	Construct bridge and gravel road to pump station			NI
Yellowstone River				
Flows	No anticipated effect on flood flow and/or ice movement.			NI
Yield	Reduced by 80,650 ac-ft/yr.			NI
Downstream Senior Rights	No Impact			NI
Bankfull Discharge @ 52,000 cfs	Reduced approximately 0.38%.			NI
Braided Characteristic	No detectable impact.			NI
Stage (At low flows: 200 cfs withdrawal at flow of 2200 cfs)	Maximum decrease of 0.75 to 0.8 in; negligible cumulative effect.			NI
Wetted Perimeter (At low flows)	Maximum decrease approximately 1.5 to 4.0 ac per river mile.			NI
Velocity (At low flows)	Maximum decrease less than 0.1 ft per second.			NI
Water Quality	Negligible impacts resulting from reduced dilution volumes. Return flows from Box Elder Creek would have negligible impact due to similar water quality and great disparity in volumes.			NI
Box Elder Creek				
Stream length inundated (mi)	3.4	2.6	4.1	0
Downstream effects (mi)	NC	NC	1.6 becoming perennial	0
Water quality	Impacts to Box Elder Creek would be similar from each reservoir site: temperature would be lowered; pH would be slightly reduced; TDS would be slightly increased; and creek substrate would maintain sands, gravel, etc.			NI
Reservoir water quality	Potential effects on quality parameters due to stratification; Insignificant impact from sediment loading.			NI

TABLE II-1 (Continued)

Potential Impact	Denny's	Belle Prairie	Box Elder	No Action
Geologic Engineering Considerations	Standard: no known problems	Thick alluvial sands: severe seepage	Standard: no known problems	NI
Groundwater	NC	NC	A general increase in subsurface groundwater; preclusion of development of groundwater resources underneath reservoir; positive impact to groundwater quality from seepage.	NI
Seepage Rates (ac-ft/yr)	NC	excessive	<100	0
Major Vegetation Habitats Affected (ac)	610*	685*	891	No Change
Big sagebrush, saltbush, rabbitbrush	428	0	60	No Change
Silver sagebrush grassland	115	0	600	No Change
Upland grassland	61	635	15	No Change
Juniper breaks	6	0	14	No Change
Hardwood draw	0	30	161	No Change
Dryland crop	0	10	2	No Change
Riparian forest	10	10	33	No Change
Rose-snowberry	0	0	6	No Change
Terrestrial Wildlife Resources	No direct loss of wildlife due to construction except for a few immobile mammals. Direct loss of animals due to operation of the project is limited to the minimal potential for bird collisions with the transmission line. Habitat loss (described above) could result in the displacement or loss of 10 to 15 mule deer and sharptail grouse. Potential increased hunting. Mitigation of potential impacts by management of lands for wildlife use.			NI
Aquatic Ecology				
Affected Habitats (ac)				
Yellowstone River	1.2	1.2	1.2	NI
Box Elder Creek	NC	NC	5.0	NI
Construction Siltation	Negligible effects on productivity.			NI
Benthic invertebrates	Minimal impacts due to losses of wetted area during low flows and entrainment: however, aquatic habitat of the reservoir would decrease total loss of organisms.			NI
Fish Species				
Yellowstone River	Minimal entrainment/impingement impact due to intake structure design; potential loss of limited amount of spawning habitat during spring low flow conditions; potential reduction of species abundance due to recreation use of Yellowstone River.			NI
Box Elder Creek	Loss of stream habitat.	Loss of stream habitat.	Loss of potential migration within Box Elder Creek; creation of 1.6 mi of perennial stream habitat.	NI
Reservoir	Creation of 750 ac of lake type aquatic habitat for stocked fish species.			0

TABLE II-1 (Concluded)

Potential Impact	Denny's	Belle Prairie	Box Elder	No Action
Threatened and Endangered Species	No anticipated impacts to threatened and/or endangered plant or animal species.			NI
Soils	No impact to prime farmland.			NI
Socioeconomics				
Social	110 temporary peak work force resulting in peak population increase of 175 persons. 10 new temporary jobs created for secondary serve sector. Negligible impacts to housing, community services and water supplies.			No Change
Recreation	Potential improvement for recreational fishing and hunting on Joe's Island, and potential improvements to fishing along mitigated section of Box Elder Creek. Potential fishery in reservoir.			NI
Economic				
Regional Economy	Positive effects of new temporary jobs, construction costs of project, and increased tax base.			NI
AUM Productivity Lost	NC	NC	180	NI
Energy	Diversion reducing electric hydropower generation at dams on the Missouri by 40,580,000 kilowatt hours.			NI
Annual Energy Consumption (million kilowatt hours)	65.5	68.6	25.0	No Change
Land Use Affected	Rangeland Dryland Crops	Rangeland Dryland Crops	Rangeland Dryland Crops	NI
Aesthetics				
Visual	Minimal deterioration of visual quality of Yellowstone and other project lands.			NI
Noise - Construction	Temporary and intermittent elevated noise levels.			NI
- Operation	Negligible impact due to housing of pumps.			NI
Air Quality	Negligible effect of fugitive dust and vehicle emissions during construction and operation.			NI
Significant Cultural Resources	Possible: 1 site	0	0	NI

* Affected area for Denny's and Belle Prairie reservoir and pump station sites only.

III. AFFECTED ENVIRONMENTS/ENVIRONMENTAL CONSEQUENCES

A. OVERVIEW OF THE AREA

As previously mentioned, detailed investigation of project alternatives was confined to the point of diversion located on Joe's Island and alternative reservoir sites within the Box Elder Creek drainage. The following overview of the area provides a regional setting for the impacts evaluation provided in Section B of this Chapter.

The YDP is located in Dawson County lying on the east-central edge of Montana (Figure I-1). Major cities in the area include Miles City, Montana, and Williston, North Dakota located 85 mi southwest and 80 mi northeast of the project site, respectively.

The regional climate is typically semi-arid continental characterized by cold winters and warm to hot summers. The climate is fairly homogeneous throughout the region as topography is not a major influencing factor. However, rapidly changing meterological conditions are common due to the often quick movement of pressure systems orignating from the Artic and Gulf of Mexico. At the Glendive weather station (16), average annual precipitation is 13 in with winter snowfalls averaging 28 in. About 80 percent of the annual precipitation falls during April to September, with June being the wettest month. The annual mean temperature in Glendive is 45.6^{o}F. The lowest and highest mean monthly temperatures are 15^{o}F in January and 74^{o}F in July, respectively. Windspeeds of 50 miles per hour (mph) or more frequently occur from the west as weather systems cross the area during spring and fall. The average length of the frost-free season is 130 days in the lower Yellowstone Valley. Visibility in the region generally ranges from 45 to 70 mi.

The project area is part of the Northern Great Plains physiographic province, characterized by rolling plains and tablelands (mesas) of moderate relief (17). The plains are notably flat to the east with occasional canyons, buttes, and valleys to the west and along major streams. Areas of badlands and isolated mountains break the continuity of the plains on the western edge of the province.

Geology of the area has been modified by continental glaciation (18, 19, 20, 21). This glaciation has resulted in deposition of material, primarily made up of clays, silts and sands with cobbles and boulders. Terraces reflect various water levels of the Yellowstone River which were probably associated with glacial advances and retreats. In the area of the proposed dam, the valley is approximately 1500 ft wide with up to 300 ft canyon side walls. Overall, sediments within this area consist of stream terraces of the Yellowstone, glacially deposited materials in the uplands, alluvial deposits within Box Elder Creek, and alluvial fan material deposited where smaller tributaries empty into the main stem of Box Elder Creek. Bedrock units are found below these unconsolidated deposits. The Fort Union Formation is the only bedrock formation which outcrops in the area. This formation was created from the eroding mountains to the west depositing sediments in what was then a fresh-water, coastal plain environment. Outcrops consist of primarily shales,

siltstones, and sandstones. In the project area the Fort Union Formation is about 100 to 600 ft thick. Vast quantities of coal (lignite) and oil and gas exist in the region and development of these resources is anticipated to continue throughout the next 30 to 40 years.

Water resources of the region include supply from both surface and groundwater sources. Use of groundwater in the area primarily includes domestic and stock watering; however, several communities in the area utilize groundwater to meet their needs. There are two municipalities within the IWC intended service area (Wibaux, Montana, and Beach, North Dakota) which use groundwater from the Tongue River, Lower Fort Union, and Fox Hills-Lower Hell Creek Aquifers. There are also 53 wells (primarily in the Tongue River Aquifer) within and around the Box Elder Creek drainage which supply from less than 5 to 50 gpm for individual domestic and stock water (22) (Table D-1, Appendix D). Groundwater quality is variable from aquifer to aquifer and within each aquifer. The water is generally a soft sodium-bicarbonate type and recommended limits of the Public Health Standards for dissolved solids, sulfates, and iron are often exceeded (10).

The primary surface water source within the region is the Yellowstone River which originates in the northwest corner of Wyoming and flows northeastward through Montana toward its confluence with the Missouri River (approximately 60 mi northeast of the project site) in western North Dakota. The lower Yellowstone River is a broad, turbid, warm-water stream with a relatively low gradient of about 2 ft/mi. Stream width varies from 490 to 1430 ft, with it being 540 ft at the potential diversion site. Major islands are common along the river. The proposed diversion site is located on on Joe's Island, one of the largest islands in the Yellowstone River. In general, low flows occur from August through February, with peak flows during June; however, individual years may vary greatly from the average year due to weather conditions in the drainage. At Miles City, average discharge of the Yellowstone is 8,390,000 ac-ft with minimum and maximum flows of 996 cfs on 14 December 1932, and 102,000 cfs on 22 May 1978. Local flooding occurs almost yearly following ice breakup in late winter. It is a common occurrence for Joe's Island to be inundated by water and ice during these conditions. There is presently no anticipated problem with water quality that would adversely affect its use.

The proposed diversion site is in a backwater created by the LYID diversion dam. The dam pools water for the diversion facility to the lower Yellowstone Project. This project was investigated and authorized in 1904 to divert water from the river to be used primarily for irrigation of approximately 52,000 ac of fertile land along the west bank of the Yellowstone. About two-thirds of the project land is within Montana and one-third in North Dakota. The project was operational in 1909 with average annual diversions in recent years of 338,800 ac-ft. The dam is a rock filled timber crib weir with a structural height of 12 ft and a hydraulic height of 4 ft.

No reservoirs of significant size occur within close proximity of the proposed project, although the Fort Peck Reservoir in Montana and Lake Sakakawea in North Dakota (both impounding the Missouri River) are located approximately 80 mi northwest and 125 mi northeast of the project site, respectively.

Ecologically, the project area is part of the Great Plains - Shortgrass Prairie Province ecosystem (23). The province is typified by soils ranging from deep, well drained loams in the valley bottoms to poorly drained saline soils on the slopes and uplands. Upland vegetation consists of sparsely distributed short grasses while the bottomland areas consist of grasses, shrubs, and trees. The province exhibits all gradations of cover from woodland to semi-desert badland zones with large areas of exposed soils.

Typical wildlife within the province includes abundant populations of pronghorn antelope, jackrabbits and desert cottontail rabbits, with smaller populations of mule and whitetail deer, and game bird populations including the sage grouse, greater prairie chicken, and sharp-tailed grouse. The project area also lies within the boundaries of the central flyway with the Yellowstone River being a major corridor for movement of waterfowl and other birds. Population estimates of breeding ducks and geese in this region are high as river backwater areas supplemented by thousands of temporal small ponds provide breeding habitat (24).

In the vicinity of the potential diversion site, the Yellowstone River provides basic types of aquatic habitat including main channel, side channel, and backwater areas. Main channel and side channel areas offer swift currents with fewer areas of silt. These areas provide passage for migratory fish species (paddlefish, sturgeon, channel catfish, walleye, sauger, burbot, etc.). The side channel south of Joe's Island provides passage for fish around the LYID dam during a few months of the year when flows exceed 16,500 cfs in the Yellowstone (14). Backwater habitat areas provide slow moving or standing bodies of water which are preferred by a number of fish and invertebrate species during periods of their life cycle. The lower Yellowstone River basin provides important regional recreational opportunities including sport fishing, hunting, swimming, and boating.

Box Elder Creek is an intermittent prairie stream with a total length of 18 miles. The creek is generally slow moving with a mud to gravel bottom. Most of the creek has abrupt grassy or brushy banks with extended areas of ditch-like habitat. Distribution of fish is limited to forage and rough-fish species. The creek does not contain significant spawning area for river species.

The economic structure of the region has historically been based largely on ranching and agriculture with only a minor percentage from industry. However, over the past 20 years, there has been a substantial shift from agriculture to other sectors of the economy (i.e., energy related industries, retail, etc.). Regional land use is still predominantly grazing of livestock (cattle and sheep) on open rangeland. In addition, extensive areas are dry land farmed mainly producing wheat and barley. Smaller areas are also surface irrigated producing small grains, potatoes and forage crops. Surface coal mining occurs in the region, while oil and gas exploration and production activities have increased rapidly in recent years.

B. IMPACT QUANTIFICATION, ANALYSIS, AND MITIGATION

Based on the proposed project description (Chapter II.C.3) and the environmental overview provided in Section A of this chapter, the affected environment of the proposed project is identified and is discussed below. Analysis of the impacts and associated mitigative actions are also discussed.

1. Surface Water

The Yellowstone River and Box Elder Creek would each be affected during the construction and operation of the proposed project. During construction, the impacts occurring on the lower Yellowstone River would be related to short-term changes of certain water quality parameters. Impacts on Box Elder Creek would also result in changes in water quality parameters due to the stream diversion and construction clearing activities. During operation of the project, minimal impacts would result from changes of flow regimes in the Yellowstone and below the dam on Box Elder Creek. Negligable impacts to water quality would also be realized in both of these locations.

a. Construction Effects

Water quality in the Yellowstone would be affected by the disturbance of the river bank and bottom during construction of the temporary coffer dam and intake structure of the pumping plant, and the pipeline and access road crossing of the side channel. The result would be a minimal increase in dissolved and suspended solids downstream of the pumping site for the duration of construction (3 to 4 months). Construction would occur during periods of low flow when minimal disturbance is anticipated. Use of the coffer dam would also reduce sedimentation impacts of those construction activities. Use of common erosion control measures (i.e., riprapping, seeding, etc.) would also be implemented. Therefore, an undetectable change in baseline turbidity would be expected during this period.

Since IWC has no rights to the waters of Box Elder Creek, existing flows would be passed through the reservoir. During construction of the dam and associated facilities, waters originating upstream would be passed by a diversion of the existing channel and any impacts would be in water quality rather than quantity. Quality changes would result from the runoff of cleared areas and from soils used in constructing the earthen dam. During runoff periods, there would be an increase of suspended solids and a lesser increase in dissolved solids originating from the site. Other runoff parameters may also exhibit short term changes. This condition would exist for approximately 26 months during construction activities. Soil stabilization measures would be utilized (where practical) to reduce impacts.

b. Operation Effects

Operation of the YDP would have no effects on downstream senior water rights; minimal effects on flow characteristics including

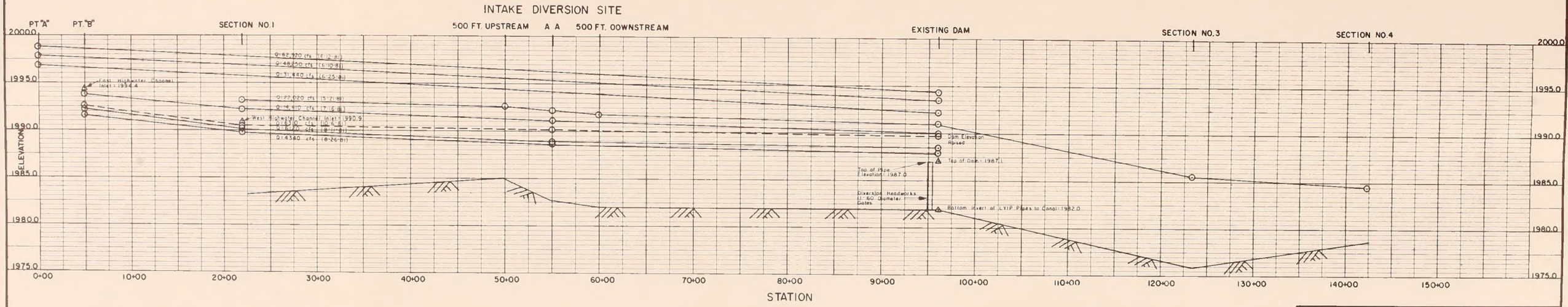
volume, velocity, river depth and wetted area; and minimal effects on water quality.

(1) Water Rights

Downstream rights that have been identified include 1300 cfs at the LYID dam and approximately 700 cfs in rights below the LYID dam to the Montana border. No other prior rights in the "apparently in use" category have been identified downstream of the YDP (2). It is anticipated that there would be no impacts to downstream senior rights due to the guidelines projected for the pumping regime and environmental commitments proposed by IWC. The proposed pumping operation would divert up to 80,650 ac-ft/yr with a maximum instantaneous diversion rate of 200 cfs. The average annual diversion rate would not exceed 111.4 cfs. Pumping at the maximum rate would require approximately 203 days to deliver the full 80,650 ac-ft. Based on a constant maximum delivery rate (net ac-ft yield) and a 25,000 ac-ft active storage (less seepage and evaporation), the longest period that pumping could be suspended would be approximately 90 days from a full reservoir condition. Diversion would cease when river flows at the point of diversion reach or drop below 4400 cfs during the irrigating season when a full 1300 cfs water right is needed by the LYID (May through September) or 2000 cfs during the non-irrigating season (October through April).

Hydrology studies of the lower Yellowstone were conducted at the IWC point of diversion and the LYID dam to correlate river stage and discharge with the LYID diversion capability. Figure III-1 shows river profiles along the YDP diversion area at various levels of discharge. At a river flow of 4340 cfs, the LYID was capable of diverting 1150 cfs with all eleven headgates fully open and a dam crest elevation of 1987.1 ft msl (14). A full diversion of 1300 cfs at this discharge would require raising the elevation of the dam. The LYID expressed concern that the YDP would reduce their ability to divert their full water right; therefore, IWC and LYID have signed a letter of understanding (Exhibit D-1, Appendix D) which reflects the intentions of IWC to assist in the maintenance and operation of the low-head dam which would assure that the LYID is capable of diverting their full right when IWC is diverting all or a portion of their right. Monitoring river flows at Glendive, the point of diversion and the LYID canal would ensure that IWC would not interfere with downstream senior water rights during periods of low flow.

These operating constraints and commitments would ensure adequate water for existing downstream senior rights. In addition, effects due to minimal drops in water elevation would have no impacts on these rights or their ability to divert the right. If an existing downstream senior diversion has difficulty during low flow, as some now do, it would continue to have those same difficulties after the YDP is constructed. Therefore, the YDP



YELLOWSTONE DIVERSION PROJECT

FIGURE III-1

YELLOWSTONE RIVER PROFILES

INTAKE WATER COMPANY

would not decrease or increase those difficulties since all pumping would cease during the periods of constraint flow mentioned above.

The proposed pumping regime reflects the capability of the YDP facilities and the lower Yellowstone River to deliver water under widely fluctuating flow rates. Studies conducted in 1981 indicate existing data at the Miles City and Sidney gaging stations to be valuable in the low flow analysis at the YDP point of diversion. The study concluded "The good correlation in 1981 flow data between Miles City and Glendive supports the use of the Miles City low flow analysis for an estimate of low flow conditions in the IWC project area..." and also "Between Glendive and Sidney the variation in flow is almost totally attributed to the LYID diversion..." (14). Historical flow records of the USGS gage at Sidney indicate that the YDP would have experienced 79 days of restricted pumping during any given year over the 29-year period of record 1951-1980 (Table D-2, Appendix D). During the low-flow water year of 1960-1961, the YDP would have been restricted from pumping for 74 days, with an additional 5 days of partial restrictions. A similar analysis of historical flow records of the USGS gage at Miles City indicates that over the 52-year period of record, a maximum of 74 days were restricted from pumping with an additional 4 days of partial restrictions in the low flow year of 1934 (Table D-3, Appendix D). It is unlikely that similar low flows would recur in the future because Yellowtail Dam, which is located on the Bighorn River, now stabilizes flows of the lower Yellowstone River. Even under historical low flow conditions, IWC would still be able to furnish firm yield water supplies and not impact downstream senior rights.

(2) Flow Characteristics

The total volume to be withdrawn (80,650 ac-ft/yr) represents about 1 percent of the average annual flow passing the point of diversion. Table D-4 of Appendix D presents the percent of flow withdrawn from the Yellowstone at a maximum rate of 200 cfs over an entire month for average, low, and high historical flows. As indicated, maximum diversion would not exceed 4.0 percent of the average monthly flow passing Sidney. Monthly maximum diversion during the 1934 low flow year at Miles City would not have exceeded 7.3 percent, while during the 1961 low flow year at Sidney, 12.5 percent would have been diverted. However, as defined within the pumping restrictions of the YDP, a maximum diversion of 9.1 percent would occur at withdrawal of 200 cfs with a river flow of 2200 cfs. Although this maximum percent would not be possible over an entire month due to river fluctuation and proposed pumping regime, actual maximum withdrawal is possible on a given day. Analysis of historical flow records indicated the potential of occurrence of maximum withdrawal on at least one day during the majority of years in the period of record.

As river flows are withdrawn, channel morphology, water depth velocity, and wetted perimeter may be affected. The following discussions examine predicted effects of the YDP withdrawal on channel characteristics below the point of diversion.

The most important geomorphic feature of the lower Yellowstone River is the braided quality of the stream channel. To maintain the integrity of this braided quality, a bankfull flow condition of 52,000 cfs should be reached in two of every three years (25).

The DNRC has studied the effects of water withdrawals on bankfull conditions in the Yellowstone River for three levels of future development by the year 2000 (26). The low, intermediate and high levels would create flow depletions of 212,500; 470,760; and 806,770 ac-ft/yr from the basin. They have concluded that these depletions would have the following effects:

1. Decreases in bankfull discharge for the mainstem Yellowstone River would range from 7.5 percent at a high level of development to between 3 and 5 percent at the low level of development;

2. Decreases in river height would be less than 0.2 ft at Miles City and 0.4 ft at Sidney at bankfull conditions under a high level of development; and

3. Decreases in width, depth and velocity would range between 1 and 3 percent at bankfull discharge under a high level of development.

Although impacts of the estimated depletions on important elements of channel form cannot be quantitatively assessed, the DNRC concluded that future depletions, though increased over historical depletion, are of similar magnitude, and it appears that historical depletion has not appreciably altered channel morphology since it was first described in 1806. Future depletions, if confined to diversion and pumping rather than on stream storage, would also have a small impact (25, 26). These depletions include irrigation use of between 59 and 74 percent, of which return flow may be as high as 18 percent of that withdrawn. Municipal use also has an associated return flow, while industrial use tends to be more consumptive. As previously mentioned, it is likely that YDP water users will fall in the municipal and industrial categories and return flows may be limited. The YDP withdrawal would be but a portion of each of these depletion levels, ranging from 37.9, 17.1 and 9.9 percent of the low, intermediate and high depletion projections, respectively. Diversions of 200 cfs during the estimated bankfull discharge would reduce this flow by 0.38 percent. The impacts to channel morphology would therefore be negligible.

The results of water surface profile data (27) showed that a flow decrease of 2000 cfs from a mean low discharge of 9000 cfs in the vicinity of the LYID dam would decrease water depth by approximately 4.8 in. Decreases of 200 cfs at a range of 2000-9000 cfs would be expected to decrease the depth about 0.75 in. Also, as presented in Figure III-1, a decrease in flow from 6120 to 4340 cfs resulted in a stage decrease of approximately 7 in at the LYID dam. Within this range, a decrease of 200 cfs would result in a stage reduction of 0.8 in. During high flows, a decrease of 200 cfs would not be measurable. Based on this data, it is anticipated that there would not be a significant decline in river height downstream of the proposed YDP diversion. There would also be no decrease in upstream stage as a result of the diversion due to flow characteristics and gradient of the river. Cumulative impacts of the YDP may be measured in terms of the effects on stage levels. Because the proposed project would have negligible effects on these levels, cumulative impacts of the YDP may be quantified as negligible.

Changes in river height would also effect the wetted perimeter of the river. Data collected (28) in the vicinity of the LYID dam indicate wetted perimeter relationships to flow (Table D-5, Appendix D). As indicated in the table, the impacts of a withdrawal of 200 cfs at flows of 2000 and 3000 would decrease wetted perimeter by 1.1 to 2.8 percent. The same withdrawal at river flows of 4000 and 5000 would decrease wetted perimeter by 0.3 to 2.9 percent. At flows of above 6000, withdrawals of the YDP would decrease the wetted perimeter by 0.2 to 1.2 percent. At low flow conditions, withdrawal of 200 cfs would have maximum impact decreasing wetted area approximately 1.5 to 4.0 ac per river mi.

River velocity is not expected to significantly change as the result of diverting 200 cfs at any time of the year. Data shows changes in average velocity (27) of subsections of a river transect below Intake with changes from 9000 to 7000 cfs. Maximum velocity changes per change in 1000 cfs were in the order of 0.2-0.25 feet per second (fps). Changes in flow on the order of 200 cfs would be hardly detectable, and the effects anticipated are insignificant. Effects of withdrawing 200 cfs on river flows of 2000-4000 cfs can be expected to have a relatively greater affect on velocity than at the 7000-9000 cfs considered by Newell; however, even at the maximum effect (withdrawal of 200 cfs at a river flow of 2200 cfs), no more than a change of 0.1 fps is expected (29).

We do not expect the proposed facilities to measurably increase the incidence of ice jams, change the location of jams, or affect ice-related flooding across Joe's Island. Jams and flooding will occur as in the past, and any influence exerted by the YDP could be extremely difficult to identify.

The proposed access bridge, pump station, and transmission line would be in areas protected by vegetation. The transmission line and pump station should have minimal effect on flood flows and/or ice movement because of their location on the island. It is anticipated that the access bridge would be either a total span or have a single pillar support. Spanning the channel would preclude obstructing it; however, this design may be impractical because of the length of span which would be needed. The proposed bridge site is in a straight reach of channel and the single pillar support, if required, would be wedge-shaped which would minimize the chances of ice jams.

Flooding and ice jams are a regular event on the Yellowstone River, with their severity depending upon weather conditions. Ice jams usually occur at sharp bends or where the river narrows. Flood flows, whether or not related to ice, alter channels and affect island stability within the floodplain. The side channel around Joe's Island acts as a natural spillway and relief valve during high water. Aerial photographs and onsite reconnaissance reveal that ice jams in the side channel have been associated with trees and sharp changes in channel direction, both above and below the proposed access bridge site (Figure II-2). It is also evident there were once other channels across Joe's Island and their former beds still carry flows when the side channel is jammed or reaches capacity. Since ice jams occur, and the floodplain and Joe's Island have changed in the historic past, it is likely that such changes will recur during the life of the project. If such changes affect IWC's (and, therefore, the Lower Yellowstone Irrigation District's) ability to divert water, it would be necessary to repair the damage as rapidly as possible.

Establishment of vegetation (including large cottonwood trees) has for the most part stabilized the Island. Core drilling has shown the Island to be adequate for construction of facilities. This construction would incorporate riprap lined embankments for protection from flood and ice damage, which may add to the overall stability of the Island.

Flows would not necessarily remain unchanged if permission to use federal lands for the YDP were denied and the project were not constructed. Communities and industrial facilities might secure water rights from the state and construct their own diversion plants, thus depleting flows in the Yellowstone. Industrial water service may also be available from federal reservoirs on the Bighorn River and its tributaries which could be delivered at points along the lower Yellowstone. Cities will grow, and it is also likely that, during the life of the project, additional irrigation will be developed along the Yellowstone and its tributaries which will also deplete flows. The extent of these reductions cannot be predicted accurately, only that some reductions in flow are almost certain.

Box Elder Creek encompasses a drainage area of approximately 140 sq mi with a total length of approximately 18 mi. The upper drainage begins at 2450 ft msl and drops to about 1900 ft msl at the mouth, where it enters the lower Yellowstone River via the Joe's Island side channel. During spring runoff, the lower mile of the creek is prone to flooding from backwater of the Yellowstone. Box Elder Creek, as a whole, is an intermittent prairie stream; several sections of which apparently flow year-round due to springs. Data collected on the creek is limited; however, estimated average yields are about 4480 ac-ft/yr, based on a mean annual runoff calculations (30). Flows in Box Elder Creek would become perennial below the reservoir to the Yellowstone River for approximately 1.6 mi due to the passage of natural flows and seepage under the dam. Also, 4.1 mi of the creek would be inundated by the reservoir. Although plans are to pass natural upstream flows through the reservoir, there would be some regulation of flows due to the associated releases. In terms of a flow regime, the same annual volume of flow would pass through the reservoir, but the distribution of flow would be partially evened out. Flows entering the reservoir would be monitored by gage installations upstream of the reservoir.

(3) Water Quality

Generally, the available data indicates there would be no serious problem with the existing or potential water quality that would deleteriously affect its use. Seasonal water quality of the Yellowstone River (31) is presented in Tables D-6 and D-7 of Appendix D for the area in the vicinity of Intake and for Sidney, respectively. Although the reservoir water quality would resemble that of the Intake data, Sidney data is presented as a downstream comparison point.

Yellowstone River water at Intake ranges from hard to very hard with the major ions being sodium, calcium, magnesium, bicarbonate, and sulfate. Studies (2) concluded that the water is generally suitable with standard treatments for municipal use, the water generally has a low sodium absorption ratio and a medium to high salinity hazard and could be used on most agricultural soils for crops with a salt tolerence, and the water would be suitable for a variety of industrial uses with standard treatments.

Water quality of the Yellowstone varies seasonally depending upon flow conditions. This is primarily due to erosion and runoff contributing natural and man-induced components. Generally speaking, turbidity, total suspended solids, fecal coliform, and agricultural parameters such as nitrogen and phosphorous are directly proportional to increases in flow. Conversely, lower flows exhibit higher concentrations of dissolved solids such as sodium, calcium, sulfate, and carbonate, and increased specific conductance. The free-flowing Yellowstone is typically free of

municipal and industrial pollution and normally exhibits high dissolved oxygen concentrations, low fecal coliform counts, and low biochemical oxygen demands.

The DNRC (32) has estimated that under the low level of development which they examined (withdrawal of 212,500 ac-ft/yr) only minor impacts to the overall water quality would occur, and only August and September would show increases in water chemistry parameters (i.e., TDS). As previously mentioned, 74 percent of the low level of development would be used for irrigation, of which as high as 18 percent may be return flows. This return is the primary reason for water chemistry changes. Negligible changes in water quality of the lower Yellowstone River are anticipated as the result of YDP water withdrawal. The only source of impact would be the loss of dilution volumes downstream. Dilution volumes of the river below the diversion point would be decreased by the project from less than 0.1 to 9.1 percent as discussed above. Presently, minor sources of constituent loadings into the river include irrigation return flow, and treated municipal and industrial effluents. As a result, the YDP diversion would not be considered to have measurable impact on downstream water quality.

Analysis of Box Elder Creek water quality is based on data collected during the limited time period of June to September, 1977 (33) and June, 1978 and 1980 (30), and is restricted to basic water quality parameters measured in the field. Within the Box Elder drainage, water quality exhibited warm summer temperatures (68-80°F), and water on the alkaline side (pH 7.6-8.7) with variable conductivity (350-5000 µmhos) throughout the basin (primarily due to seepage from groundwater). Dissolved oxygen values seemed to be stable, ranging from 6.8 to 9.5 mg/l. These data reflect standing water conditions or low flow and may vary considerably during higher flow periods.

Water quality of the 1.6 mi reach of Box Elder Creek would be effected by project operation. Because water released from the reservoir would have dropped its sediment load, creek substrate below the dam is likely to have fewer silts and more areas of gravel bottom as the existing fines are washed out. When operation begins, water in the creek below the reservoir would reflect the water quality of the reservoir. A comparison of existing water quality data from Box Elder Creek and the lower Yellowstone River suggests the following: pH would remain on the alkaline side, but may average slightly lower than presently exists; conductivity below the reservoir would fluctuate less than present baseline conditions and resemble the conductivity regimes in the Yellowstone; temperature regimes in the creek may be altered as they would be dependent upon water temperatures within the reservoir, specifically upon the temperature within the zone of release. Should a thermocline (the zone of interaction between two layers) develop in the reservoir during

limited pumping, oxygen in the lower levels could drop, which would be passed into the creek. It is anticipated that the flow from Box Elder Creek dam seepage and reservoir releases would not cause detectable changes in water quality at the lower Yellowstone River, considering the disparity in volume.

Operation of the YDP would create a storage reservoir of 25,000 ac-ft within the Box Elder Creek Drainage. The quality of the water in the proposed reservoir would primarily reflect that of the Yellowstone River at the point of diversion. As the project is designed, water would be pumped over the dam and discharged at a point 500 ft in the reservoir. Outlet of water would be from the bottom of the reservoir at the dam. As water is converted from its lotic (flowing) state in the river to a lentic (still) state in the reservoir, changes in water quality would be expected to occur. Suspended solids would settle to the bottom, decreasing the turbidity. Dissolved solids would increase slightly as evaporation occurs. During the first 10 to 20 years, full sales are not anticipated and the reservoir is expected to be maintained at half to three-fourths capacity. During this period, a lesser amount of water would be pumped and released. In this situation, a slight increase in the concentration of dissolved constituents is anticipated to occur. In addition, a standing body of water may tend to stratify during the summer with the warmer water on top and colder water at the bottom. The thickness of these layers and the nature of the thermocline is dependent upon numerous factors; i.e., climate, depth, season, morphology of the reservoir itself, etc. A variety of water chemistry changes may occur within the bottom layers, most notably a significant decrease in dissolved oxygen. It is anticipated, however, that with the inlet/outlet design, weather conditions of the area (wind and precipitation), and inflow of Box Elder Creek, stratification would not occur during stable levels of the reservoir. During full sales, the reservoir would vary from maximum to minimum capacities and water would maintain the approximate inflow quality of the Yellowstone River.

(4) Reservoir Life

The reservoir should last as long as water is diverted and the site is irretrievably committed to that use for all practical purposes. The sediment deposited in the reservoir would be a combination of the sediment yield from the drainage area for Box Elder Creek and the sediment load of the lower Yellowstone River which would be pumped from the intake structure. As calculated, sediment accumulation would be approximately 0.09 in/ac/yr over the entire reservoir or 1.25 in/yr if all sediment was deposited within the minimum pool. This minimal influx of sediment would have negligable effects on reservoir storage capacity or water quality. Also, because of the general fine texture of deposited materials, the sediment could help seal the reservoir from leakage.

2. Geology/Groundwater

a. Geology

No impacts to geologic structures of the area are anticipated from development of the proposed project.

Preliminary core drilling and engineering analysis indicates that this is a viable location for the dam, reservoir, and associated facilities. In terms of safety, this area has no active faults or other geologic hazards. Construction of the dam and other project facilities will conform to standards under the USCE permitting program.

A letter (Exhibit D-2, Appendix D) from the U.S. Geological Survey to the BLM identifies the 40 ac tract of BLM land within the reservoir site as containing mineral resources of sodium, oil and gas, and coal. Development of these resources is unlikely in the near future due to the depth and low market value of sodium, the limited quantity of coal (lignite) and the unknown potential for oil or gas on this lease. Construction of the reservoir would not preclude development of oil and gas (34). As mentioned previously, vast quantities of coal exist within the project region. A total of 24 potential lease tracts have been identified with total reserves estimated at 7.8 billion tons (35).

b. Groundwater

Minor changes in the groundwater system would be confined to the shallow subsurface system of the Fort Union Formation in the vicinity of the proposed reservoir and down-gradient of the reservoir to the Yellowstone River. These impacts essentially consist of two types: 1) a general increase in the groundwater level within the down-gradient or downstream portion of the reservoir; and 2) the preclusion of the development of groundwater supplies in the area covered by the reservoir. These impacts are considered minimal because they would not deprive water supplies from either present or potential users of groundwater in the vicinity of the site.

A general increase in the elevation of the water table would occur in the vicinity fringing the reservoir, and a negligible rise in the water table would occur in the Box Elder Creek floodplain downstream of the dam facilities. A subsurface contour map (Fig. D-1 of Appendix D) for the Tongue River Aquifer was constructed using available water level information for water wells in the area. The figure also indicates locations of the water wells as compiled in Table D-1 of Appendix D. The figure illustrates that the general groundwater flow in the Box Elder drainage basin is in a northwesterly direction toward the Yellowstone River. Locally, groundwater flow is influenced by topography and surface drainage features generally flowing toward the creeks. There would be no impacts to the general groundwater flow characteristics in the area as a result of the proposed project.

The rate of seepage underneath the dam and into the valley walls was computed with the use of a flow net equation (Fig. D-2 of Appendix D). The results represent conservative estimates (actual seepage rates would probably be lower) in that the impermeable nature of the dam, the grout curtain around the abutments, and a clay blanket extending upstream 500 ft from the abutments were not considered in the analysis. Results indicate a seepage of approximately 55 ac-ft/yr underneath the dam and 12 ac-ft/yr into the valley walls adjacent to the reservoir. An additional calculation was performed assuming that seepage will occur along the entire reservoir with results indicating a maximum possible rate of only 25 ac-ft/yr. Total seepage out of the reservoir would be less than 100 ac-ft/yr and is insignificant compared to the estimated loss of 1600+ ac-ft/yr resulting from evaporation (13). Of the seepage, most of this water would be lost to evapotranspiration and the remainder would be transmitted either laterally through the strata where it would discharge into surface water drainages downgradient of the reservoir, or be transmitted vertically and add to the recharge of the groundwater system. Because of the low permeability of the canyon strata and associated low flow rates, aquifer flooding is not considered to be of significance.

Minimal seepage is expected from the reservoir with flow underneath the dam estimated at a rate of less than 100 ac-ft/yr. Available water quality data indicates that the water of the lower Yellowstone River is of significantly better quality than the groundwater existing in the Fort Union Formation. Maximum concentrations of TDS in the lower Yellowstone River is found to be less than 900 mg/l, while TDS average 1250 mg/l or greater in the groundwater supplies of the Fort Union. Therefore, surface waters of the reservoir infiltrating into the groundwater resources would improve groundwater quality. Any groundwater discharges into the surface water drainages downstream of the facilities would reflect the quality of the reservoir influenced by that of the aquifer contacted. As calculated, this groundwater seepage may result in a maximum flow of 0.14 cfs. Impacts would be insignificant and limited to the shallow subsurface groundwater system of the Fort Union Formation and would consist, for the most part, of a slight increase in the suspended solids and a slight decrease in pH.

3. Ecology

a. Vegetation

Vegetation types within the project area which would be affected include upland grassland, silver sagebrush-grassland, hardwood draw, big sagebrush-saltbush-rabbitbrush, dryland crop, juniper breaks, riparian forest and rose snowberry. Five vegetation types have been identified within the dam and reservoir site. These include upland grassland (15 ac), silver sagebrush-grassland (568 ac), big sagebrush-saltbush-rabbitbrush (60 ac), juniper breaks (14 ac), and hardwood draws (160 ac). The pump station would occupy 10 ac of riparian

forest with the pipeline and access road traversing 21 ac of riparian forest, 31 ac of silver sagebrush-grassland, 6 ac of rose snowberry, and one ac of hardwood draw. The transmission corridor would cross 2 ac of riparian forest, one ac of silver sagebrush-grassland, and 2 ac of croplands. The pump station and associated facilities would be located in a relatively open area where few trees need to be removed during construction. Vegetation impacts are anticipated to be minimal because none of these vegetation types are unique for the general project area and the acreages of these communities that will be disturbed are relatively insignificant when compared to their abundance in the region.

Impacts to vegetation resulting from the proposed project would occur on 891 ac of which 86 ac will be reclaimed following construction activities. At the dam site, vegetation would be removed on approximately 67 ac (of which 28 ac would be reclaimed). At the pump station site, 6 of the 10 ac of vegetation would be removed for the project's life. Along the transmission line ROW a small amount of vegetation would be temporarily disturbed at each structure location north of the river (total of approximately 3 ac), and an additional 2 ac would be disturbed for the pole structures located on Joe's Island. In addition, some trees may have to be pruned or removed in the transmission ROW to facilitate line stringing operations. The pipeline ROW would temporarily disturb 43 ac and the gravel access road and bridge would disturb an additional 16 ac (of which 8 ac would be reclaimed). Within the reservoir area, 750 ac of vegetation would be lost due to flooding. Prior to flooding, trees and shrubs within the reservoir area would be removed by a proposed chaining and burning program that would facilitate maintenance of the outlet works during project operation.

An additional undetermined area may be disturbed for borrow of riprap and/or soil cement materials. Within those five areas identified (Chapter II.C.3), vegetation is similar to that of the project area and impacts would be related to removal of vegetation and borrow material followed by reclamation and revegetation of the areas. Land use of these areas is primarily grazing, although two of the areas have been used as borrow areas in the past.

Areas disturbed during construction would be revegetated as soon as possible. Generally, areas would be seeded with native or adapted grass species to provide erosion protection. Seed would be drilled where slopes are less than 25 percent and hydroseeded at twice the seeding rate on steeper areas (dam face). These areas would be straw mulched with the mulch held in place by either physical (crimping) or chemical (asphalt tack) means. Nitrogen fertilizer would generally be applied at a rate of 40 to 60 pounds per acre to enhance seedling establishment, vigor, and growth. Tree and shrub growth would be inhibited along the pipeline corridor to protect the integrity of the pipe, while trees would be planted around the pumping station to provide a visual screen.

Implementation of the proposed project would eliminate existing vegetation in the reservoir area; however, aquatic and wetland habitat would be created in the reservoir and its perimeter. During initial operation of the project, full sales of water may not be achieved and the level of the reservoir may remain relatively constant. In which case a zone of wetland vegetation would develop along the waterline. When the project is in full operation the drawdown zone would be barron.

b. Wildlife

The primary impacts to wildlife resulting from implementation of the proposed project would be those associated with habitat alteration and minimal reductions in populations. A number of important groups of wildlife have been identified within the project area including big game, upland game birds, waterfowl, furbearing mammals, non-game species, and raptors. Impacts associated with habitat loss and modification would have minimal effect on these groups. The species of local importance are the snapping turtle, whitetail and mule deer and sharp-tailed grouse. The snapping turtle is a state-listed species of special concern and only one was sited during field reconnaissance (30), impacts to the snapping turtle are anticipated to be minimal. Whitetail deer, mule deer, and sharp-tailed grouse, however, are abundant in the project area. The loss of habitat at the pump station and reservoir sites would not result in the direct loss of any animals but would force the animals to utilize other nearby areas to meet their habitat requirements. Also, because of the potential for increased recreation use and activity due to construction and operation of the project, animals may also be lost through increased hunting, poaching, and/or human disturbance. From population characteristics data collected within the Box Elder drainage (36), project related pressures may cause the whitetail and mule deer population to be decreased by 10 to 15 animals. Impacts on sharp-tailed grouse are anticipated to be negligible. In addition, a limited number of relatively immobile mammals (i.e., mice, shrews) may be eliminated during construction and inundation. As discussed previously, impacts to the lower Yellowstone habitat would be minimal, thus, secondary impacts to species which are dependent on aquatic systems (i.e., waterfowl, riparian furbearers) would be negligible.

The proposed area of disturbance would be lost for use by terrestrial wildlife. The dam, reservoir, and pump station sites would permanently reduce wildlife habitats (loss of approximately 805 ac). In addition, 86 ac would be disturbed only during construction and reclaimed upon completion of facilities. As previously mentioned, eight vegetation habitat types would be affected. Of these,

hardwood draw (161 ac), riparian woodlands (33 ac) and juniper breaks (14 ac) have been identified as supporting the greatest diversity of wildlife. These impacts would be associated with potential displacement of wildlife and would be mitigated on lands set aside and managed for wildlife habitat. Extent and location of these lands has not been determined and will be dependent on negotations with land owners.

The project would require approximately 4 mi of transmission line with a crossing of the Yellowstone River. Potential impacts of proposed transmission line projects on birds may occur either directly or indirectly because of construction and/or operation. The direct impacts as identified by literature include loss of habitat, mid-air strikes or collisions, electrocution, and disturbance due to construction and maintenance.

The most significant potential impact to birds is related to collisions with the transmission lines. The most consistent victims of wire strikes are large migratory water birds (37, 38, 39, 40). Efforts to quantify the potential collision impacts on bird populations have been fruitless. However, it is generally recognized that siting efforts are the primary method of mitigating such potential impacts. The location of the proposed line was selected within close proximity to the existing LYID rock tram line. It has been found that location of new lines would have a lesser impact if located near existing lines which add to their visibility and require a single flight maneuver to clear. It is not felt that the proposed line would cause significant collision impacts.

The proposed transmission line would be designed to preclude electrocution of birds by the distance between conductor and pole structure or ground wire being a minimum of 90 in. This distance is greater than the wingspan of birds which occur in the area.

Nearly all of the identified impacts to wildlife can be mitigated. Most areas where habitat would be disturbed by construction activities would be immediately revegetated. To mitigate the loss of hardwood draw on the reservoir site, the section of Box Elder Creek below the dam and undetermined areas on the south and west side of the reservoir would be fenced to protect it from grazing by domestic animals and make it available for wildlife use. An informal verbal agreement reached on 12 May 1982 between IWC and MDFWP (Exhibit C-1 of Appendix C) indicates that during land acquisition for the project, additional lands will be utilized for mitigation of wildlife impacts. MDFWP and USFWS will be kept apprised during the acquisition program and will be solicited for their comments and recommendations. Comments would address relative value and suitability of lands and management options.

c. Aquatic Ecology

Project-related impacts to aquatic systems can be identified as short-term construction and long-term operational effects. Short-term construction impacts associated with habitat loss would occur on both the lower Yellowstone River at the pump station site, pipeline crossing, and access bridge, and on Box Elder Creek at the point of the pipeline crossing, dam construction, and area of diversion. Long-term operational impacts associated with habitat loss and modification would occur on Box Elder Creek in the area of inundation and below the dam structure. Preclusion of project development would remove potential impact to aquatic systems.

On the lower Yellowstone River, construction of a coffer dam, dredging and construction of the intake structure, and placement of riprap for shore and bank protection would cause minor short-term losses of the aquatic habitat. Quantification of these impacts include disturbance of 450 ft of existing shoreline and 1.2 ac of bottom habitat. Based upon the relatively small area involved and the temporary nature of the disturbance to aquatic habitat, no detectable effects on species composition or abundance is anticipated. Following construction, the creation of solid substrate because of the placement of riprap is likely to attract aquatic species. Impacts of construction siltation on downstream habitat is also expected to be undetectable due to the limited disturbed area, short period of construction, and erosion control measures.

Productivity of benthic organisms could be effected by changes in flow regime or by entrainment of drifting organisms through the intake system. Impact to benthic production would primarily occur from loss of wetted streambed. In low flow conditions this could be from 1.5 to 4.0 ac per river mile or an average of 2.75 ac/mi. However, during low flow conditions, flows may naturally go below the 2000 or 4400 cfs pumping limitation, thus, the YDP would only contribute to naturally occurring benthic impacts. Since losses in productivity also depend upon the length of time an area is exposed and the ability of organisms to move as well as recolonize, it is concluded that a worst case maximum loss of 190-200 ac of benthic productivity (from the point of diversion to the Missouri River) could occur as a result of project operation in low flow conditions. In considering loss of productivity, the worst case assumes no movement or recolonization of benthic life that would reduce losses. A probable loss would be one-half of the worst case, or approximately 100 ac.

Benthic organisms can also be lost from the river as the result of entrainment in the diversion water. Without the availability of specific data, entrainment of drifting benthic organisms can be considered to be proportional to the percent of the river flow that passes the point of intake. As described in the surface water section (Section 1.b.2 of this chapter) the percentage of flow that would be taken at the maximum pumping rate of 200 cfs under all conditions of river flow would be from less than 0.1 to 9.1 percent. For the most

part, these percentages are minimal, and consequent loss of benthic drift organisms are anticipated to be insignificant; however, the organisms lost to entrainment can be considered net losses to the food and energy base of the lower Yellowstone River and a net gain to the reservoir system. Also, drift organisms are a small percentage of total productivity and bottom dwelling organisms would not be impacted. It is, therefore, concluded that losses of benthic organisms and/or benthic productivity would be negligable.

Entrainment and impingement of adult fish, fish larvae and eggs would be minimal due to the "state of the art" design of the intake structure (as described in Chapter II.C.3.b). This design would mitigate potential impacts. In addition, a memorandum of agreement between IWC and MDFWP has been signed (Exhibit C-2 of Appendix C) which will allow studies to be conducted at the point of diversion for the purposes of assessing the effectiveness of the instrumentation and to make recommendations regarding specific times of protected operation. IWC will operate the instrumentation pursuant to these recommendations so long as it does not adversely affect IWC's pumping regime.

Other impacts to fish may include a temporary loss in suitable spawning habitat for walleye, sauger and other species on the gravel bar below the existing diversion dam during low flow periods. This gravel bar provides considerable spawning habitat, and was reported (41) that reductions in flow below 5000 cfs over the bar would result in potential dewatering of eggs, increased silt deposition, and/or a reduction in the number of spawning fish. A memorandum of agreement between IWC and MDFWP has been signed (Exhibit C-3 of Appendix C) which states that IWC will endeavor to allow a desired 5000 cfs instantaneous minimum flow to pass the point of diversion during April and May to the extent that it does not interfere with or infringe upon IWC's water right. Should the flow fall to or below 5000 cfs during this period, IWC will notify MDFWP of the flow and intended pumping plans for the next 10 days. This coordination is intended to enable MDFWP to make recommendations as they feel appropriate to protect fish spawning and incubation and to monitor potential impacts to fishery resources.

Within the side-channel of the Yellowstone, construction of the pipeline and access bridge would disturb 100 ft of the aquatic habitat; however, construction of these facilities would take place during the dry periods of this side-channel resulting in negligible impacts. As all areas of disturbance on the Yellowstone would be riprapped, impacts of downstream siltation would be negligible. Also, as those construction activities would take place during low flow periods, fish and other aquatic life would not be effected.

Based on the above analysis, there would be no aspect of the project operation that would either eliminate or add to the species composition of the lower Yellowstone River nor significantly change the community of aquatic organisms that now exist in the vicinity of the proposed project or downstream.

Long-term impacts to Box Elder Creek ecology include the loss of 5.0 ac of intermittent stream habitat, and the severing of the upper drainage from the lower portion of the creek and Yellowstone River due to the dam and reservoir. Construction would eliminate the potential for fish migration from the Yellowstone into the upper drainage of the creek. However, existing aquatic populations do not seem to be dependent on this movement and should not be impacted. Selection of the Denny's Alternative would eliminate any potential impact of facilities on fish migration due to its location in the drainage.

Construction of the dam and reservoir facilities would disturb 4.1 mi of Box Elder Creek. The creek would be permanently diverted through the outlet works of the dam. As these activities would take place during the dry periods of the year, sedimentation of downstream areas (as discussed in the surface water section) in Box Elder Creek and the Yellowstone River would have minimal impact on the aquatic system. As indicated, this portion of Box Elder Creek is classified as intermittent with limited aquatic habitat. No springs, ponds or potholes were located during the baseline survey (30). Therefore, it has been concluded that aquatic life of Box Elder Creek should not be significantly impacted by the proposed project.

The 1.6 mi section of Box Elder Creek from below the proposed dam to the Yellowstone would become perennial as a result of the project. This would create permanent aquatic habitat for benthic and fish organisms.

d. Endangered Species

The USFWS memorandum of 23 November 1981, which provided an initial assessment of impacts on fish and wildlife resources which would result from construction of the proposed YDP, provided a list of endangered and/or threatened species which might occur in the project area. The service listed bald eagle, peregrine falcon, whooping crane, and black-footed ferret.

The YDP would have no effect on the listed species. There are no wetlands which would be likely to attract migrant whooping cranes in the project area or prairie dog towns which would supply a food source for black-footed ferrets.

Bald eagles regularly fly and feed along the Yellowstone, but there are no reported nests or roosts in the project area and no cliffs which would provide nesting sites for peregrine falcons. The project would not reduce the food supply for either species. Transmission lines which serve the project will be constructed so as to preclude accidental electrocution of large birds. It is possible that the offstream reservoir may attract nesting waterfowl, but we doubt if it will measurably increase feeding opportunities for either eagles or peregrines and thus add to the attractiveness of the area for either species.

4. Soils

The soils of the Box Elder site are generally deep with gentle to moderate slopes. The textures are generally loamy, ranging from fine sandy loam to silty clay loam. Although no cropland would be excluded from production, some soils classified as "prime if irrigated" and "of statewide importance" would be inundated by the reservoir. No soils have been classified as prime farmland in the area.

Impacts to soils would occur as the result of implementation of the proposed project. These impacts should not, however, be of major consequence and should, for the most part, be mitigatable by use of appropriate reclamation measures. Vegetation would be removed to facilitate construction resulting in temporary exposure of the soil to wind and water erosion. In addition, soil compaction would also occur in this area and along the access road due to the continued movements of the heavy construction machinery. Accelerated erosion could take place along the reservoir shoreline as the result of wave action and wind erosion from the exposed areas resulting from the fluctuating water level. The potential wind erosion is discussed in the air quality section of this chapter. No significant impacts to soils are anticipated along the transmission corridor north of the river with only small areas disturbed at the location of each line structure.

The previously described soil impacts resulting from construction would be readily mitigated by the appropriate reclamation procedures. Disturbed areas located at the dam site, pump station, and along the pipeline, transmission line and access routes would be contoured, harrowed, and reseeded with appropriate species. A slight crown of soil would be left on the backfilled pipeline trench to compensate for the anticipated subsidence. Topsoil will be salvaged and stockpiled from the area to be disturbed by construction. This soil will be redistributed to those disturbed areas. The back face of the dam would be covered with soil cement or riprap to minimize erosion while the front face would be hydroseeded and mulched to help keep the soil in place. Riprap would also be placed on the dike protecting the pump station from high water and ice flows in the Yellowstone River. Areas within the dike would be covered with gravel to protect the soil and facilitate easy maintenance.

5. Socioeconomics

a. Population

No significant increases in population are expected in the project area as a result of construction or operation of the YDP. It is currently projected that the peak temporary construction force for the project would be 110 people with an average of 60-80 workers over a 2 year period. Approximately 40 workers of the peak temporary construction force would be provided from the local labor pool. These employees are projected to be a significant portion of the average employment for the project. It is projected that approximately 70 members of the peak construction work force would come

from outside the project area (29). This is due to the relatively low unemployment rate in the project area (2-3 percent), the small size of the local construction related labor pool, and the specialized nature of project construction.

Dawson County, in general, has experienced relative minor growth during the period 1970-1980. During this decade the county population grew from 11,269 to 11,805 residents for a gain of 536 persons (4.7 percent). During the same period, the Glendive area experienced a rate of increase (10.2 percent) growing from 9205 residents in 1970 to 10,253 residents in 1980. In contrast, Richland County grew from 9,837 to 12,243 residents for a gain of 2,406 persons (24.4 percent) during the period 1970-1980. The city of Sidney grew 26 percent during the period with a population increase of 4543 to 5726 residents. During the 1970-1980 period, Wibaux County increased from 1465 to 1476 residents (0.75 percent), while the town of Wibaux increased from 644 to 782 residents (21.4 percent) (45). Although anticipated future area population increases will be energy related, it is projected that project area growth would proceed at a rate of approximately 2 percent per year if the YDP was not constructed (46, 47).

The operational work force for the project would consist of two full time employees. Supplemental labor for maintenance of the pump station, pipeline and reservoir would be provided through contracts with service companies. Operation of the proposed project would have an insignificant impact on the population of the project area.

It is anticipated that temporary construction-related population increases would occur in both Dawson and Richland Counties. Population increases in the Wibaux area are considered unlikely due to current growth capacity and distance from the proposed project (42). It is assumed that the majority of this growth would occur in Dawson county, predominantly in the city of Glendive. Richland County growth, which would probably occur in the community of Sidney, would be minimal due to distance from the project site.

Based on the assumed 70 people in the peak temporary construction work force coming from outside the area, the anticipated peak increase of population directly related to the project would be approximately 175 people. It is felt that this population increase would be temporary. The projected population increase is based on the following assumptions:

1) Approximately 60 percent of these employees would be married with an average family size of 3.5 persons (43). Total direct increase of 147 people is projected from this work force component. (Note: the 3.5 family size is an average value typical of energy project related growth and may over-estimate impacts associated with the proposed project. Recent experience on a coal fired power plant in western North Dakota indicates in migrating construction workers had family sizes averaging

2.29 persons (44)). It therefore appears likely that the projection presented here is a maximum expected figure; and

2) Approximately 40 percent of the employees would be single. The total increase for this component is projected to be 28 persons.

Based on the aforementioned assumptions, the anticipated project related population increases for Dawson and Richland Counties are 157 and 18 persons respectively. Based on assumptions previously outlined, the construction of the proposed project would cause temporary and intermittent increases in population for Dawson and Richland Counties (1.3 percent and 0.1 percent, respectively).

b. Employment

Available information indicates that the project area (Dawson and Richland Counties) have typically experienced relatively low unemployment rates. Dawson County's 1981 annual unemployment rate was approximately 3.1 percent. Richland County recorded a 2.3 percent rate for the same period. During 1981 there were approximately 600 total construction workers in Dawson and Richland Counties (48). As previously indicated, approximately 36 percent of the project construction work force would be recruited from within the project area. It is anticipated that the majority of the project-related non-skilled type construction jobs could be filled by area residents.

In addition to direct project related jobs, a limited number of additional secondary or service sector, jobs would be created (43). This increase is caused primarily by the creation of jobs in service type establishments in the project area. Based on experience gained in similar construction projects in the Rocky Mountain area, it is projected that less than 10 service sector jobs would be created by the proposed project. This relatively low level of secondary jobs is due to the nature of project construction which requires very little materials support. Most of these secondary jobs would be filled by project area residents most likely from the Glendive area (44).

Proposed project construction would positively impact project area employment by creating approximately 120 direct and indirect temporary new jobs, of which approximately 50 jobs will be filled by area residents. Due to the low operational work force requirements, the proposed project would have an insignificant effect on area employment.

c. Housing

The construction of the proposed project would have a minor impact on available project area housing. During the period of peak construction, the vacancy rate for rental occupied units is expected to drop slightly. The total number of housing units may rise temporarily if members of the construction work force move mobile

homes into area communities to provide temporary housing. Housing currently available in the area is sufficient to accomodate the projected construction work force. The operation of the proposed project would not impact housing in the project area.

The housing situation in Dawson and Richland counties is fairly typical of rural areas in the Rocky Mountain West. Communities in the project area have experienced slight growth in the number of housing units during the past 10 years. During the last 3 years approximately 60 percent of the new housing units in Dawson County have been mobile homes (47).

In 1980, Dawson County had a total of 4637 housing units, of which 3095 or 66.8 percent were classified as owner occupied. The vacancy rate for these units was a relatively low 1.6 percent (approximately 50 units). The renter occupied units accounted for 23.4 percent of the total housing units and had a vacancy rate of 6.6 percent (approximately 65 units). Richland County followed a similar pattern with a total of 4690 units, of which 2956 or 63 percent were owner occupied. The vacancy rate for owner occupied units was 1.4 percent (approximately 41 units). Renter occupied units, on the other hand, had a 5.1 percent (approximately 68 available units) vacancy rate (49).

d. Community Services

(1) Water Supply

Both the communities of Glendive and Sidney have sufficient capacity to provide water services to the slight increase in population resulting from the proposed project. Residents of Glendive are served by two water systems. One includes treatment of surface waters from the Yellowstone River and two mineral wells. The current treatment capacity is approximately 4.2 million gallons per day (mgpd). The storage capacity of the system is approximately 2.0 million gallons (gal). Usage of the Glendive water system ranges between 1.4 and 4.9 mgpd. The West Glendive area is served by a groundwater system with a capacity of approximately 0.5 mgpd, and a storage capacity of 330,000 gal (47). The Sidney community water system, on the other hand, is a groundwater system capable of producing 3.5 mgpd. The storage capacity of the system is currently 1.3 million gal. The peak usage of the Sidney system is estimated currently at 2.3 mgpd. Although population increases resulting from the proposed project would undoubtedly cause additional usage in project area communities, no expansion of existing water systems would be needed (46).

Several major projects are currently projected for the region which could exceed or strain capacity of existing water systems. The proposed Fort Union Coal Regional leasing program has been analyzed and is expected to create between 9,000 and

30,000 jobs, depending upon the final scale of leasing and development (35). A single coal gasification facility stemming from these leases is expected to create 1,000 construction and 400 operational jobs. Although the distribution of these population increases to specific communities has not been projected, it is obvious that associated growth would cause significant strain on community water supply systems. For example, the Glendive water system has excess treatment capacity but lacks sufficient storage capacity to handle significant growth. The West Glendive water system would be strained with only a 5 percent growth (160 persons). Sidney has a current excess production capacity of approximately 1.2 mgpd, and could conceivably handle moderate growth. It is likely that most of the small communities within the region are also faced with similar low to moderate water supply growth capacities. Any major project constructed within the region would create significant need for additional water supplies to meet such industrial population growth. Water from the YDP (having both firm annual quantity and quality) represents a viable alternative to other sources. As previously noted, groundwater quality in the project area is highly variable and often contains excessive levels of TDS, sulfates and iron. As indicated, municipalities of the area generally utilize groundwater for supply; however, additional water which could be supplied by the YDP would be of better quality requiring only minor treatment prior to use.

(2) Wastewater Treatment Systems

Community wastewater treatment systems in Glendive and Sidney currently have sufficient capacity to handle the anticipated population increases resulting from the proposed project. Glendive is presently served by two systems. The Glendive municipal system is a lagoon system capable of servicing 7800 people. The West Glendive system is also a lagoon type system currently servicing approximately 2600. It is anticipated that the West Glendive system would be expanded in the near future (47).

Sidney is served by a community wastewater treatment system utilizing lagoons. The present capacity of the system is 1 mgpd. Current loading of the system is approximately 60 percent of capacity (46).

Although approximately 23 percent of the Dawson County population is served by septic tank systems, it is projected that all growth associated with the proposed project would occur in areas served by community systems.

(3) Transportation

During the construction phase of the proposed project, it is anticipated that minor impacts to the existing project area

transportation system would occur. These impacts would be limited to increased traffic volumes on state highways and county roads in the project area. Vehicular traffic would include private vehicles belonging to members of the project work force and truck traffic associated with the delivery of construction materials to the project site. The quality of the existing transportation system would not be degradated as a result of the proposed project.

(4) Schools

It is currently projected that project related growth would increase by less than 100 students. Existing schools systems in Dawson and Richland Counties have sufficient capacity to handle this growth. This potential impact would be further minimized by the timing of peak construction activities, which would occur during summer months (47).

(5) Health Care

Due to the relative low population increases resulting from the project, existing health care facilities within Dawson and Richland Counties have sufficient capacity to maintain present levels of health care service.

(6) Police and Fire Protection

Service levels for police and fire protection in Dawson and Richland Counties are currently considered adequate. Anticipated population increases resulting from the project would not be significant to impact the present level of police or fire protection in area communities.

e. Recreation

The proposed project would affect recreational opportunities in several ways. First, project related population increases would place additional demands on the existing recreational system. Existing facilities in area communities have sufficient capacity to handle this growth. Second, the proposed project would impact recreation facilities and wildlife species through increased access to the project area.

Joe's Island now provides seasonal access for sport fishing of paddlefish, walleye, sauger and channel catfish, and hunting for deer and a variety of game bird and waterfowl species. The Intake Fishing Access Site (located approximately 1 mi downstream of the point of diversion) provides access to the lower Yellowstone River for as many as 1000 people a day during annual paddlefish snagging season (50). With all-weather access to Joe's Island being provided through the project, recreational use of the area would be greatly increased. The use of Joe's Island would also be compounded by the proposed

development of a recreational facility to be located in the LYID dam area. In a memorandum of understanding between IWC and MDFWP (Exhibit C-4 of Appendix C) the proposed facility would utilize IWC's all-weather access and would be constructed at the same time as the YDP facilities. All necessary permits, authorizations, and clearances will be obtained by MDFWP who will also maintain the facilities. This facility may increase fishing pressure on the river fishery (primarily paddlefish) and may also result in attendant sanitation impacts.

The construction of a 750-ac reservoir would also provide recreational opportunities. In a memorandum of agreement between IWC and MDFWP (Exhibit C-5 of Appendix C) public access to the resevoir for recreational purposes will be allowed. MDFWP has agreed to manage and maintain the facility for recreational purposes at its sole cost and expense. Provisions of the agreement include: stocking and maintenance of fish populations; no motorized boats will be allowed on the reservoir; policing of the reservoir; maintenance of trash receptacles and collection; no vehicular traffic around the reservoir; IWC has sole right of reservoir water for beneficial use; recreation of the reservoir may be limited due to fluctuation caused by use; and, IWC has limited liability for the facility as used for recreation under the provisions of 70-16-301 and 70-16-302.

Development of the YDP would increase the recreational value of federal lands which presently have limited access and no recreational management. It would also open approximately 800 ac of private lands which are presently not available for public recreational use.

f. Economics

(1) Regional Economy

Historically, the economy of both Dawson and Richland Counties has been based primarily on agriculture. This situation has changed, however, in the past 10 years. In 1973, agriculture provided approximately 35 percent of the personal income and approximately 14 percent of the jobs in Dawson County. Richland County followed a similar pattern. By 1978, agriculture provided only 5.0 percent of the Dawson County personal income although agricultural jobs accounted for approximately 11 percent of the total jobs in Dawson County. This change reflects a nation-wide trend of reduced profitability for agricultural operations. Losses from the agricultural sector were offset by substantial gains in the mining, transportation/public utilities, state/local government, and retail trade sectors. Personal income from all sources increased 17 percent for the period 1973-1978 (45).

The YDP would affect the project area economy in several ways. First, personal income generated by the construction sector would increase through the creation of new jobs. It is projected

that approximately 70-80 percent of the income from YDP employment would be spent within the project area. Second, it is estimated that approximately 98 percent of the projected project cost would be spent within the project area during the two-year construction period. In addition, taxes resulting from the project would be paid on an annual basis throughout the project construction and operation life. The combination of these factors would significantly increase the total revenue for the project area, particularly during the construction phase of the project (29).

During low flow years, future water users may not have adequate supplies to meet their requirements. Further development of regional resources and consequent growth of the economy might be limited by water supply. However, industrial water service in the area might be provided by releases from existing federal reservoirs on the Bighorn River, a tributary of the Yellowstone. Impacts of federal water marketing are described in an impact statement being prepared by BR.

Inundation over the 750-ac site and construction of project facilities would result in a loss of 180 animal unit-months (AUM) of grazing potential. This figure may increase slightly due to use of borrow areas and land acquisition for the project. Some of these lands to the south and west of the reservoir would be fenced for mitigation of lost hardwood draw and wildlife displacement.

(2) Energy

A projected impact of the proposed project would be the removal of 80,650 ac-ft of water which may be utilized for downstream hydropower generation. It has been calculated that this diversion would reduce generation by 40,508,000 killowatt hours annually at dams downstream on the Missouri, 0.4 percent of that presently generated. Also, it has been calculated that the project would utilize 25,000,000 kilowatt hours of power annually to pump water from the Yellowstone to the reservoir. This power is presently available from the area utility.

(3) Secondary Impacts of Water End-Use

As specified in IWC's water right, areas which have been identified for potential use include irrigation, municipal, domestic, and/or industrial. IWC presently has no commitment or contracts to supply water for any purpose.

In the above areas, industry seems to be the most likely end-use. Energy related industries would need water for future project development. These plans, for example, include coal gasification and/or conversion facilities. Projects of this type and magnitude would be subject to the Montana Major Facilities Siting Act, and

possibly the National Environmental Policy Act as well, which requires analysis of impacts of each project. One such assessment is BLM's Fort Union Coal Leasing EIS (35) which has analyzed impacts of coal leasing and industrial development in the project area.

In 1982, Tenneco Coal Gasification Company announced long-range plans to construct a coal gasification plant near Glendive, Montana. A typical lignite coal gasification plant using the Lurgi gasification process would produce an average of 250 million standard cubic feet per day of synthetic gas. The gasification complex situated near its coal source would consist of coal preparation, storage, and handling; gasification units; process facilities; pollution control facilities; and ancillary facilities. The total land area dedicated to a gasification plant site would be about 1000 ac (not including the coal mine or product pipeline) (35).

The supporting process facilities would include steam generation and distribution, power generation and distribution, oxygen production, raw water supply and water treatment, and fire protection. A water intake pipeline would draw water from a nearby source (i.e., the YDP). Water requirements for the gasification facility would be approximately 10,000 to 15,000 ac-ft/yr. The waste water treatment system would be designed for maximum reuse within the plant. No waste water would be discharged to surface waters. Gaseous waste streams from the gasification process and coal combustion may include particulates (4 tpd), sulfur dioxide (30 tpd), carbon dioxide (30,000 tpd), water (7,900 tpd), hydrogen sulphide (0.5 tpd), nitrogen and noble gases (61,000 tpd), and nitrogen oxide (35 tpd). Waste solids from coal processing, waste water treatment units, and from the ash handling system (7,000 tpd) would be dewatered and probably disposed of at the mine. Byproducts such as sulfur (200 tpd), phenol (166 tpd), ammonia (124 tpd), tar (1,100 tpd) and naptha (150 tpd) would be recovered, stored, and either consumed in the plant or sold (35).

Changes in land use due to a gasification facility would include displacement of existing use, increased intensity of existing uses, and the introduction of new uses. This would result in the loss of annual production on crop and rangeland. The most likely recreational use (hunting of big and small game) would be affected. Wildlife could be impacted from destruction of habitat and direct and indirect impacts from the increase in human population. If powerlines, pipelines, access and haul roads are constructed in key wildlife areas, partial or total destruction of habitat would occur depending on the magnitude of development. Impacts on vegetation would occur as a direct result of facilities construction and possibly from deposition of air-born pollutants downwind of the facility. Cultural resources may be affected, and visual impacts may occur due to air emissions causing atmospheric discoloration and haze. The construction of a gasification facility would take approximately five years. Construction employment would average 1000 with operation

employing 400. Construction and operation of the facility would result in significant impacts upon services in communities within the area as a result of population growth associated with employment opportunities. Estimated new population would average 3500 during construction and 2700 during operation (35).

Additional discussions and analyses concerning impacts of coal gasification can be found in other environmental impact statements written for this region (35, 51, 52, 53, 54).

It is assumed that other water needs in the areas of municipal, domestic, and/or irrigation would not be subject to the Major Facilities Siting Act, although the nature and magnitude of these projects are not anticipated to have significant environmental impact.

g. Land Use

The only significant effect on land use of the proposed project would be the conversion of approximately 891 ac of wildlife and grazing habitat into the proposed reservoir and associated facilities. A similar acreage and associated land use would be utilized if the Denny's alternative were selected. Preclusion of development of the project would maintain the present land use, grazing, and wildlife habitat. Of the 891 ac proposed for the Box Elder reservoir and facilities, 95 ac are BR lands and a small portion of the 40-ac BLM tract would be effected. The remainder (approximately 800 ac) is private land. Considering the amount of similar land use acreage in the project area and proposed mitigative measures, this conversion constitutes a minor impact to the existing environment. The major impact would be the change in land use due to increased access to Joe's Island and the reservoir site. The bridge and all-weather access to the island would increase use of the area when high water normally restricts use. The reservoir site would also realize increased use because of the recreational resource.

h. Aesthetics

Those project facilities which would be visible following construction include the pump station, transmission line, access bridge, reservoir, and dam and associated facilities. However, due to topography of the area and associated vegetation, visual impacts of the project would be limited. The reservoir, dam, and associated facilities would be constructed within Box Elder Canyon and would be visible only from a portion of Belle Prairie Road. The pump station, transmission line, and access bridge would be partially visible from River Road and State Highway 16. Should the underground transmission line alternative be used from the pump station to the dam, visual impacts from River Road would be minimized. Also, limited removal of trees during construction and planting trees around facilities following construction would reduce visual impacts.

As this project would not emit any type of pollutant into the environment, visual impacts would be limited to direct observation within one or two miles from project facilities. In addition, facilities would be painted to blend into the surrounding environment.

Regulating reservoirs as the type proposed in this project often times have extensive exposed shoreline for extended periods during drawdown. An analysis of historic river flows indicate that during a given month there may be a wide fluctuation of water level; however, the established pumping regime would limit the period in which shoreline would be exposed. This would minimize aesthetic impacts to the reservoir and surrounding area.

The proposed project occurs in a rural area which typically has a low population density. The distance to the nearest residence from project related noise sources is approximately 3/4 of a mile. Construction of the proposed project would cause temporary deterioration of noise quality in the vicinity of the project site; however, the impact of any high noise levels would be short term. Elevated noise levels resulting from the long-term operation of facilities would be primarily related to operation of turbine pumps used at the proposed pump stations. Noise levels would be reduced by enclosing the pumps in a building. Based on the lack of major population concentrations in the immediate vicinity and design considerations of the project, the impact of noise on the human population would be considered negligible.

6. Air Quality

Because of the limited amount of equipment required for construction, a 26-month construction period, and revegetation of disturbed areas, air quality impacts from the vehicle emissions and fugitive dust are anticipated to be relatively insignificant. During operation, the potential for fugitive dust from exposed shoreline of the reservoir is expected to be minimal because of the relatively short duration of exposure during drawdown. The minimal amount of fugitive dust that would result from the proposed project would not be expected to have an impact on human populations. No occupied dwellings occur within several miles in the direction of the prevailing wind (southeast). Also, this project would not emit any type of air-born pollutant or stream plume.

7. Cultural Resources

No known cultural resources would be affected by the proposed project. During a cultural resource survey of the proposed pump station and Box Elder drainage (55), several sites of minimal activity (loci/isolator) were identified including one on the Denny's site, but none were found on the Box Elder site. The State Historic Preservation Officer concurred that none of the sites qualify for listing in the National Register of Historic Places (Exhibit D-3, Appendix D).

IV. LIST OF PREPARERS

This EIS was prepared by Espey, Huston & Associates, Inc., Engineering and Environmental Consultants for the Bureau of Reclamation and Intake Water Company. The following persons, consultants, and agencies provided input to this document.

Espey, Huston & Associates, Inc.

Jerry H. Koblitz - Senior Staff Ecologist: Project Manager, Aquatic Ecology. B.S., Wildlife Management, University of Wisconsin. Ecologist 9 years, Project Manager 7 years.

John R. Schenck - Denver Manager: Quality Assurance/Review Officer. B.S., Biology, East Central State College, Oklahoma, M.S., Aquatic Biology, Southwest Texas State University. Biologist 9 years, Project Manager 6 years.

Tom Partridge - Senior Groundwater Hydrologist: Groundwater Hydrology. B.S., Geology, Mississippi State University, M.S., Geological Engineering, University of Missouri-Rolla. Geologist 4 years, Groumdwater Hydrologist 10 years.

Gilbert R. Ward - Staff Hydrogeologist: Geology, Groundwater Hydrology. B.S., Geology, University of Texas at Austin. Groundwater/Hydrology Technician 2 years, Hydrogeologist-Water Quality 4 years.

Billy J. Goolsby - Staff Hydrologist: Surface Water Hydrology. B.S., Civil Engineering, New Mexico State University. Mining Engineer 4 years, Highway Engineer- Drainage Systems 5 years, Hydrology Engineer 4 years.

Randall E. Schroeder - Staff Ecologist: Terrestrial Ecology (Wildlife, Vegetation, Soils), Air Quality. B.S., Range-Forest Management, Colorado State University (CSU), M.S., Range Ecology, CSU. Range Conservationist 2 years, Ecologist- Reclamation Specialist 4 years.

George D. Wolf - Senior Staff Community Development Specialist: Socio-economics, Noise. B.S., Biology and Anthropology, Eastern New Mexico University, M.S., Environmental Sciences, University of Oklahoma. Field Environmentalist 3 years, Economic Development Planner/County Manager 2 years, Environmental Consultant/Community Development Specialist/ Project Manager 4 years.

Other Contributors

Richard Echols - Intake Water Company: Project Description Information

Ted Johnson, Stan Thorfinson, Robert J. Irish - Woodward Clyde Consultants - Consulting Engineers, Geologists, and Environmental Scientists. Project Feasibility, Geotechnical and Borrow Area Studies.

Robert C. Erickson, Ph.D. - Environmental Consultant: Preparation of Environmental Assessment Report and Aquatic Surveys of Box Elder Creek.

Rodger Foster - Morrison-Maierle, Inc. - Consulting Engineers: Yellowstone River Stream Gaging and Hydrology Surveys.

Linda Ward-Williams - Montana Tech Foundation, Mineral Research Center, Cultural Resources Division: Cultural Resource Surveys.

Jon Swenson - Montana Department of Fish, Wildlife and Parks (Fish and Game): Terrestrial Wildlife and Yellowstone River Aquatic Life Studies.

V. INDEX

APPENDIX A - DISTRIBUTION LIST

Entities from Whom Comments Have Been Requested or Received

A. Draft Statements distributed by the Commissioner of Reclamation for Review and Comment:

Department of the Interior

Director, Bureau of Land Management
Assistant Secretary, Indian Affairs
Director, Bureau of Mines
Director, U.S. Fish and Wildlife Service
Director, National Park Service
Director, U.S. Geological Survey
Missouri River Basin Commission

Other Federal Agencies

Council on Environmental Quality
Advisory Council on Historic Preservation
Department of Agriculture
Department of the Army, Corps of Engineers
Department of Health, Education, and Welfare
Department of Transportation, Regional Director, Region VIII
Federal Energy Regulatory Commission
Environmental Protection Agency, Regional Administrator, Region VIII
Department of Housing and Urban Development, Regional Administrator, Region VIII
Honorable Ronald Marlenee, State Congressional Representative, 409 Cannon HOB, Washington, D.C. 20515
Honorable Pat Williams, State Congressional Representative, 1233 Longworth HOB, Washington, D.C. 20515
Honorable Max Baucus, Office of the Senator, 1107 Derkson SOB, Washington, D.C. 20510
Honorable John Melcher, Office of the Senator, 253 Russell SOB, Washington, D.C. 20510

B. Draft Statements distributed by the Regional Director for information:

Department of the Interior

Special Assistant to the Secretary, Missouri Basin Region, Building 67, Room 688, Denver Federal Center, Denver, CO 80225
Regional Director, U.S. Fish and Wildlife Service, 10597 West 6th Avenue, Denver, CO 80215
Area Manager, U.S. Fish and Wildlife Service, 316 North 26th Street, Federal Building, Room 3035, Billings, MT 59101
Area Director, Bureau of Indian Affairs, 316 North 26th Street, Billings, MT 59101
State Director, Bureau of Land Management, 316 N. 26th, Billings, MT 59101
District Manager, Bureau of Land Management, P.O. Box 119, Miles City, MT 59301
Chief, Intermountain Field Operation Center, Bureau of Mines, Building 20, Denver Federal Center, Denver, CO 80225
Regional Director, Rocky Mountain Region, National Park Service, 655 Parfet, P. O. Box 25287, Denver, CO 80225

Regional Hydrologist, Water Resources Division, U.S. Geological Survey, Building 25, Denver Federal Center, Denver, CO 80225
District Chief, Water Resources Division, U.S. Geological Survey, Federal Building, Drawer 10076, Helena, MT 59626

Other Federal Agencies

Regional Director, Economic Development Administration, Suite 505, Title Building, 909 - 17th Street, Denver, CO 80202
State Conservationist, Soil Conservation Service, Bozeman, MT 59715
Area Conservationist, Soil Conservation Service, Glendive, MT 59330
Director, Regional Technical Service Center, Soil Conservation Service 134 S. 12th Street, Lincoln, NE 68508
District Engineer, Omaha District, Corps of Engineers, 7410 U.S. Post Office and Courthouse, 215 N. 17th Street, Omaha, NE 68101
Administrator, Western Area Power Administration, 1536 Cole Blvd., P.O. Box 3402, Golden, CO 80401
Regional Administrator, U.S. Environmental Protection Agency, 1860 Lincoln Street, Denver, CO 80295

Federal-State Agencies

Chairman, Missouri River Basin Commission, Suite 403, 10050 Regency Circle, Omaha, NE 68114
Honorable Max Baucus, Office of the Senator, 2708½ 1 Ave. N., Billings, MT 59103
Honorable John Melcher, Office of the Senator, 316 N. 26th, Billings, MT 59103
Honorable Ronald Marlenee, State Congressional Representative, 2717 1 Ave. N., Billings, MT 59101
Honorable Pat Williams, State Congressional Representative, P.O. Box 1981, Helena, MT 59601

C. Draft Statements distributed by the Regional Director inviting comments:

Honorable Ted Schwinden, Governor of Montana, State Office Building, Helena, MT 59601
Director, State Clearinghouse, 1424 9th Avenue, Helena, MT 59601
Department of Community Affairs, Eastern Montana Field Office Hagenstrom Building, Glendive, MT 59330
Director, Montana Environmental Quality Council, Capitol Building, Room 138, Helena, MT 59601
Director, Montana Department of Fish, Wildlife and Parks, 1420 East Sixth Avenue, Helena, MT 59601
State Historic Preservation Officer, 25 North Roberts Street, Helena, MT 59601
Director, Department of Health and Environmental Sciences, Capitol Station, Helena, MT 59601
Director, Department of Natural Resources and Conservation, Natural Resources Building, Helena, MT 59601
Honorable Allen I. Olson, Governor of North Dakota, State Capitol, Bismarck, ND 58501
Director, North Dakota State Planning Division, State Capitol, Bismarck, ND 58505
Chairman, Northern Plains Resource Council, 421 Stapleton Building, Billings, MT 59101
Ms. Connie L. Eaton, Northern Plains Resource Council, Field Office, Box 886, Glendive, MT 59330
Gentry Land and Livestock Company, Belle Prairie Route, Glendive, MT 59330

Mr. Patrick Carnahan, 97 Lawrence Drive, Longmeadow, MA 01106
Center for Public Interest, Inc., P.O. Box 931, Bozeman, MT 59715
League of Women Voters of Montana, 3220 Country Club Circle, Billings, MT 59101
County Agent, Dawson County, Glendive, MT 59330
Mr. Gottlieb Schmierer, President, Savage Irrigation District, 7th Avenue, S.W., Sidney, MT 59270
Mr. George Rice, President, Intake Irrigation District, 7th Avenue, S.W., Sidney, MT 59207
Mr. Glen Asbeck, President, Lower Yellowstone Irrigation District No. 1, 7th Avenue, S.W., Sidney, MT 59270
Mr. Gene Denowh, President, Lower Yellowstone Irrigation District No. 2, 7th Avenue, S.W., Sidney, MT 59270
Mr. Wayne Heimbuch, President, Yellowstone Basin Water User Association, P.O. Box 886, Glendive, MT 59330

County Commissioners

Montana

Custer County Commissioners, Courthouse, Miles City, MT 59301
Prairie County Commissioners, Courthouse, Terry, MT 59349
Dawson County Commissioners, Courthouse, Glendive, MT 59330
Richland County Commissioners, Courthouse, Sidney, MT 59270
Wibaux County Commissioners, Courthouse, Wilbaux, MT 59353
Dawson County Conservation District, Courthouse, Glendive, MT 59330

North Dakota

Golden Valley County Commissioner, Courthouse, Beach, ND 58621

City Councils

Montana

City Council, Glendive, MT 59330
City Council, Wibaux, MT 59353

North Dakota

City Council, Beach, ND 58621

Public Libraries

Montana

Montana Environmental Library University of Montana, Missoula, MT 59801
Billings Parmly Library, 510 N. Broadway, Billings, MT 59101
Miles City Public Library, 1 S. 10th Street, Miles City, MT 59301
Glendive Public Library, 106 S. Kendrick, Glendive, MT 59330
Sidney Public Library, 121 3rd Ave. NW, Sidney, MT 59270
Wibaux Public Library, Box 332, Wibaux, MT 59353
Lewis and Clark Public Library, 120 Last Chance Mall, Helena, MT 59601

North Dakota

Golden Valley Public Library, Beach, ND 58621

APPENDIX B - CONSULTATION, COORDINATION

B. COORDINATION AND CONSULTATION

Planning for the YDP has been in progress since the early 1970's. However, litigation over the water right associated with this project delayed planning and permitting activities until 1976 when the Montana State Supreme Court upheld the existing water right for this project. Since the initiation of the project, several environmental and engineering studies have been implemented with guidance and input from various governmental agencies. These studies have resulted in an extensive data base that describes existing baseline conditions.

The NEPA process was implemented because federal lands would be affected by the project. BR and IWC agreed to employ a "third-party" consultant to prepare the formal EIS document. A Memorandum of Understanding (MOU) defining this agreement was prepared by the BR and signed by IWC on 6 October 1981. In accordance with guidelines identifying procedures for "Third Party" selection, Espey, Huston and Associates (EH&A) was awarded the contract to develop this EIS.

In 1973, BR provided IWC a tentative outline of the EIS identifying topics which would need to be considered. Subsequently, IWC contracted with several consultants to develop engineering and environmental baseline information concerning the following disciplines: aquatic life, terrestrial life, cultural resources, geology, hydrology, water marketing surveys, and preliminary design of facilities. This baseline information was reviewed and analyzed by IWC for preparation of the Project Environmental Assessment Report (EAR) which was published in April, 1981. On 30 September 1981, copies of the EAR were distributed by the BR to interested state and federal agencies, as well as concerned citizens who were requested to review the document and present formal comment during the scoping process.

A notice of intent to prepare this impact statement and notice of the public scoping meeting was issued by the BR and published in the Federal Register

on 22 October 1981. This notice was also published in the Miles City newspaper on 2 November 1981. The notice formally scheduled the scoping meeting in Billings, Montana and also set the stage for a second meeting to be held in Glendive, Montana if sufficient public interest was expressed to the BR by 13 November 1981. An apparent lack of public interest precluded the need for the Glendive meeting. On 17 November 1981, the formal scoping meeting was held in Billings. A list of those in attendance is included as Table B-1. During the scoping session and subsequent discussions, BR, IWC, and EH&A attempted to identify all significant issues, federal actions, required permits, and alternatives to the project. Final scope of the statement was determined by BR.

Primary issues raised during scoping were:

- USCE identification as a "cooperating agency";
- Relationship of IWC's water right to various legislation;
- Effects of withdrawal on downstream flows, water quality, fish life, and other water users;
- Relationship of IWC to LYID;
- Description of project components including criteria for pumping and operation;
- Potential for dust from exposed beaches due to reservoir drawdown to effect air quality;
- Potential for transmission line and access bridge across the side channel to cause ice to block the channel;
- Project energy requirements;
- Short-term construction related water quality impacts;
- Potential creation of springs or saline seeps and associated impact on groundwater and Box Elder Creek;
- Potential socioeconomic impact of work force on housing, public services, etc;

- o Potential fish and wildlife impacts;
- o Agency responsibility to ensure compliance with permit stipulations; and
- o Secondary impacts of "realistic" and "reasonable" end use of project water.

Throughout the planning of the project, IWC consulted several federal and state agencies which have provided advice that has assisted in the preparation of this document and mitigative strategies for potential impacts.

The USCE involvement as a cooperating federal agency has ensured coordination of the EIS process with the application of several required permits. The USCE has provided consultation for the application of the Section 10, 404 and 402 permits, and discussion of dam engineering design safety standards. In addition, public hearings scheduled for the formal EIS review process will also consider the application of these permits.

The USFWS has met periodically with IWC and BR to ensure fish and wildlife resources were adequately evaluated. In addition, the agency has provided a review and assessment of the intake screening system design, ensuring measures were taken to mitigate potential losses to aquatic life resources of the Yellowstone River.

The MDFWP has worked with IWC on a paddlefish study completed in 1974, an aquatic ecology study of the Yellowstone River completed in August 1976, and terrestrial baseline studies completed in 1978. In addition, the MDFWP provided input into the final engineering design of the intake screening system, with emphasis on ensuring mitigation of potential losses to aquatic life. The MDFWP has also negotiated with IWC in formulating specific mitigation strategies to be implemented at several stages of project development and/or operation. These agreements are included in Appendix C, Environmental Commitments.

USCE and BLM were requested by letter dated 21 May 1982, to review a preliminary draft of this document and advise whether it met their needs for permitting and right-of-way issuance. Comment letters resulting from their review have been included within this Appendix.

The following permits are required for the Yellowstone Diversion Project before commencement of construction and/or operation.

Federal

- Right-of-way Permit - BR: (Construction and Operation Phases) -- powerline, pipeline, access roads, diversion site, dam site, and inundated land area;

- Right-of-way Permit - BLM: (Operation Phase) -- inundated land area;

- Section 404 (Federal Water Pollution Control Act) - USCE: (Construction Phase) -- dredge and fill operation on Yellowstone River, dam construction on Box Elder Creek;

- Section 10 (Rivers and Harbors Act) - USCE: (Construction Phase) -- dredge and fill operations associated with intake structures on the Yellowstone River, power transmission line, and bridge (issued in conjunction with 404 permit);

- Section 402 (Water Quality Certification) - EPA: (Construction Phase) -- certification of discharge to the lower Yellowstone River; and Montana Pollutant Discharge Elemination Systems (MPDES) permit for batch plant discharges;

Montana

- 310 (Montana Natural Streambed and Land Preservation Act) - Dawson County Conservation District: (Construction Phase) -- dredge and fill operations in the lower Yellowstone River;

- Air Quality (Clean Air Act of Montana) - DHES: (Construction Phase) -- batch plant;

- Montana Open Cut Mining (Open Cut Mining Act) - Department of State Lands: (Construction Phase) -- Borrow excavation operations for bentonite, clay, sand and/or gravel for dam construction;

- Montana Hard Rock Mining Operating Permit (Montana Hard Rock Mining Act)- Department of State Lands: (Construction Phase) -- Borrow excavations for riprap.

TABLE B-1

ATTENDANCE LIST

Scoping Meeting for Yellowstone Diversion Project EIS

17 November 1982

Bureau of Reclamation P.O. Box 2553 Billings, MT 59103	Bureau of Land Management P.O. Box 940 Miles City, MT 59301
U.S. Fish and Wildlife Service Federal Building 316 N. 26th Billings, MT 59101	U.S. Army Corps of Engineers Omaha District U.S. Post Office and Court House 215 N. 17th Street Omaha, NE 68102
United States Geological Survey 2525 4th Avenue W. Billings, MT 59101	U.S. Environmental Protection Agency Montana Office Drawer 10096 Federal Building Helena, MT 59601
Department of Natural Resources and Conservation 32 S. Ewing Helena, MT 59601	Northern Plains Resource Council 419 Stapleton Building Billings, MT 59101
Intake Water Company P.O. Box 2511 Houston, TX 77001	Tennessee Gas Transmission Company P.O. Box 2511 Houston, TX 77001
Tenneco Coal Company P.O. Box 491 Glendive, MT 59330	Espey, Huston & Associates, Inc. 7800 East Union Avenue, Suite 930 Denver, CO 80237

EXHIBIT B-1

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

Lower Yellowstone Project, Montana

License to Construct, Operate and Maintain a Pumping Plant and Its Facilities Upon, Under, Over and Across Reclamation Land

THIS CONTRACT, entered into this 19th day of June, 1973, pursuant to the Act of June 17, 1902 (32 Stat. 388), as amended and supplemented, between the UNITED STATES OF AMERICA, hereinafter called the United States, represented by the contracting officer executing this contract, and the Intake Water Company, a corporation created under the laws of the State of Delaware, whose address is Post Office Box 2511, Houston, Texas 77001, hereinafter referred to as the Licensee.

WITNESSETH, THAT:

WHEREAS, the following preliminary statements are made in explanation.

a. The United States, has constructed the Lower Yellowstone Diversion Dam on Yellowstone River in Montana, and has thereby impounded water for diversion to lands of the Lower Yellowstone Project.

b. The Licensee has applied for right-of-way to construct, operate and maintain a pumping plant and its facilities above the site of the Lower Yellowstone Diversion Dam and has also applied for a right-of-way for a water pipeline upon, under, over and across the following described lands:

T. 17 N., R. 56 E., P.M., Montana,
Sec. 1, Lots 1 and 4.
T. 18 N., R. 56 E.,
Sec. 35, Lot 5, 6 and 7;
Sec. 36, Lot 7, SE¼SW¼, SW¼SE¼.
T. 17 N., R. 57 E.,
Sec. 6, Lots 3, 4, SE¼NW¼ and SW¼NE¼.

all shown on Exhibit "A" attached hereto and by this reference made a part hereof.

c. The above-described lands are Federal lands under the administrative jurisdiction of the United States Department of the Interior, Bureau of Reclamation, under the provisions of said Act of June 17, 1902 (32 Stat. 388), as amended and supplemented by the Act of August 4, 1939 (63 Stat. 1187) as amended and supplemented, and subject to an existing lease for agricultural and grazing purposes to Gentry Land and Livestock, Inc. of Glendive, Montana; and

d. The Secretary of the Interior is authorized by Section 10 of the Act of August 19, 1939 (53 Stat. 1187) to grant licenses for right-of-way across withdrawn and acquired lands on such terms and conditions as he may determine.

e. It is contemplated that the Licensee will enter into a contract with the Board of Control of the Lower Yellowstone Irrigation Districts Nos. 1 and 2, present operators of the Lower Yellowstone Project, under which the Licensee will accept an appropriate share of the O&M costs of the Lower Yellowstone Diversion Dam; also that the Licensee shall make appropriate arrangements with the existing lessee of the lands above described.

NOW THEREFORE, in consideration of the premises and the mutual promises of the parties, the United States hereby grants to the Licensee, a license for a period of forty (40) years commencing on 1st day of June, 1973, and ending June 30, 2013, but revocable as herein provided, to construct, operate, and maintain a pumping plant, intake structure and access road, together with a pipeline to transport water for sale and for its own use, upon, under, over and across the land depicted on the attached Exhibit "A" and in consideration thereof. The Licensee agrees and stipulates:

1. That the Licensee shall pay to the United States compensation for the administration of this agreement in the amount of $750 payable in advance.

2. Licensee hereby releases, and agrees to indemnify and hold harmless the United States, its successors and assigns, from any and all damages or claims of every description, or kind whatsoever, which may result from the construction, operation and maintenance of any facilities upon said land. The Licensee shall indemnify and save the United States, its officers, agents, and employees and its successors or assigns, harmless from and against claims by third parties for loss or injury caused by any damage to or from the pumping plant intake structure, access road, and water pipeline.

3. Licensee's facilities shall be so erected and maintained as not to obstruct in any manner the flow of water from the Yellowstone River into the Projects main canal. It is understood and agreed by the Licensee that any future repairs or additional maintenance to said Project's main canal or the Lower Yellowstone Diversion Dam which shall become necessary because of the existence of the Licensee's facilities, shall be performed by the United States, its successors or assigns, and the Intake Water Company, its successors or assigns shall reimburse the United States, its successors or assigns, for the expense of such repair and maintenance. The determination of the Secretary of the Interior as to the amount of such expense shall be final and binding upon parties hereto.

4. The United States reserves to itself the right to construct, use, and maintain irrigation facilities, electric transmission, telephone, telegraph, water, sewer lines, and other facilities across, over and under the right-of-way hereby granted.

5. In any areas damaged by the Licensee's operations, the Licensee shall restore the ground surface to its original contour and reestablish the grass cover as required by the contracting officer, for watershed protection and erosion prevention.

6. The United States reserves to itself the right to flood the premises when and as required.

7. The shoreline and roads will at all times be open to the public unless subsequent regulations by the State of Montana or any Federal agency prohibit such privileges.

8. Licensee shall take appropriate measures in designing and constructing the pumping plant profile so as not to diminish current aesthetic values and shall give due recognition to the ecology of the area. In developing plans for the plant, appurtenant structures, transportation, transmission facilities, rights-of-way for water handling facilities, a pipeline to transport its product out of the area, and other actions, appropriate measures will be taken to minimize adverse effects on the environment. Licensee's plans and programs for implementing these measures, including noise abatement, dust abatement, and disposal of wastes shall be subject to review and approval by the United States prior to construction, installation, removal, or major modification of License's facilities. At least once every five (5) years thereafter, the United States shall review and approve Licensee's operation to assure that the Licensee is utilizing then current techniques and developments for minimizing any adverse effects of Licensee's operations.

9. Licensee shall use the land in such a manner as to control the growth and spreading of noxious weeds and promote acceptable conservation of the land. Also, the Licensee shall consult with and obtain the consent of the United States for the establishment of any species of plants proposed on the premises. The Licensee shall further cooperate in weed control programs in compliance with P.L. 90-583, which authorizes representatives of public bodies to enter Federal land to control noxious weeds under certain specified conditions.

10. Licensee's use of pesticides on land covered by this license shall comply with all provisions of Federal and State pesticide laws, amendments thereto, and Department of the Interior's policies. The Licensee is prohibited from using chemicals listed on the Department of the Interior's current prohibited list; chemical toxicants for killing predator mammals or birds; and chemical toxicants which cause secondary poisoning for killing mammals, birds, and reptiles. Written approval of the Bureau of Reclamation is required prior to any use of pesticides on the land.

11. Licensee agrees that it will furnish data and information to the United States as may be required for preparation of an environmental statement pursuant to the National Environmental Policy Act of 1969 (Public Law 91-190), as it may be amended. No development will be allowed on the site until an environmental statement has been prepared by the United States in compliance with said act and until the United States, in its sole discretion, approves the use of land.

12. This license may be terminated by Commissioner of the Bureau of Reclamation upon a reasonable notice to the Licensee if the Commissioner of the Bureau of Reclamation shall determine that the right-of-way hereby authorized interferes with the use of said land or any part thereof by the United States or may be terminated by the Commissioner of the Bureau of Reclamation for failure, neglect or refusal by the Licensee fully and promptly to comply with any and all of the conditions of this grant, or for nonuse, or for abandonment.

13. Upon the expiration or termination of this license, the Licensee shall without expense to the United States and within such time as the Commissioner of Bureau of Reclamation may indicate, remove said facilities and lines from said lands and restore the premises hereby authorized to be used and occupied to a condition satisfactory to the contracting officer. In the event the Licensee shall fail, neglect, or refuse to remove said facilities and lines and so restore the premises, the United States shall have the option either to take over said facilities and line as the property of the United States without compensation therefor, or to remove the said facilities and line and perform the restoration work as aforesaid at the expense of the Licensee, and in no event shall the Licensee have any claim for damages against the United States or its officers or agents or successors, on account of the taking over of said facilities and line, or on account of its removal.

14. Neither this license nor any interest herein shall be transferred by the Licensee without written consent of the United States made by the Officer executing this license on behalf of the United States, and until payment has been made to the United States of the sum of Fifty and no hundredths dollars ($50.00) to cover the expense of approving of such transfer.

For the following articles numbered 16, 17, and 18, the Licensee is referred to as the Contractor.

OFFICIALS NOT TO BENEFIT

15. No Member of or Delegate to Congress or Resident Commissioner shall be admitted to any share or part of this contract or to any benefit that may arise herefrom; but this provision shall not be construed to extend to this contract if made with a corporation or company for its general benefit.

COVENANT AGAINST CONTINGENT FEES

16. The Contractor warrants that no person or selling agency has been employed or retained to solicit or secure this contract upon an agreement or understanding for a commission, percentage, brokerage, or contingent fee, excepting bona fide employees or bona fide established commercial or selling agencies maintained by the Contractor for the purpose of securing business. For breach or violation of this warranty the Government shall have the right to annul this contract without liability or in its discretion to add to the contract repayment obligation or consideration the full amount of such commission, percentage, brokerage, or contingent fee.

EQUAL OPPORTUNITY

17. During the performance of this contract, the Contractor agrees as follows:

a. The Contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. The Contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, sex, or national origin. Such action shall include, but not be limited to the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided setting forth the provisions of this Equal Opportunity clause.

b. The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, or national origin.

c. The Contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice to be provided advising the said labor union or workers' representative of the Contractor's commitments under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

d. The Contractor will comply with all provisions of Executive Order No. 11246 of September 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor.

e. The Contractor will furnish all information and reports required by Executive Order No. 11246 of September 24, 1965, and by the rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records, and accounts by the administering agency and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

f. In the event of the Contractor's noncompliance with the Equal Opportunity clause of this contract or with any of the said rules, regulations, or orders, this contract may be canceled, terminated or suspended in whole or in part and the Contractor may be declared ineligible for further Government contracts or Federally assisted construction contracts in accordance with procedures authorized in Executive Order No. 11246 of September 24, 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order No. 11246 of September 24, 1965, or by rule, regulation, or order of the Secretary of Labor, or as provided by law.

g. The Contractor will include this Equal Opportunity clause in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to Section 204 of Executive Order No. 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The Contractor will take such action with respect to any subcontract or purchase order as the administering agency may direct as a means of enforcing such provisions including sanctions for noncompliance: Provided, however, That in the event the Contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the administering agency, the Contractor may request the United States to enter into such litigation to protect the interests of the United States.

WATER AND AIR POLLUTION CONTROL

18. The Contractor shall, within its legal authority, comply fully with all applicable Federal and State laws, orders, and regulations, all as administered by appropriate authorities, concerning the pollution of streams, reservoirs, groundwater, or water courses with respect to thermal pollution or the discharge of refuse, garbage, sewage effluent, industrial wastes, oil, mine tailings, mineral salts, or other pollutants, and concerning the pollution of the air with respect to radioactive materials or other pollutants. The Contractor further agrees that any contract it may enter into with a third party will contain a similar water and air pollution control article.

19. Wherever the "United States, its successors or assigns" are used herein, it is understood that said words shall include the Lower Yellowstone Irrigation Districts Nos. 1 and 2 as the successor of the United States in the control of the operation and maintenance of the Lower Yellowstone Project.

IN WITNESS WHEREOF, the parties hereto have caused this agreement to be executed the day and year first above written.

THE UNITED STATES OF AMERICA

By Acting Regional Director, UM Region
Bureau of Reclamation
P. O. Box 2553
Billings, Montana 59103

Appd. Sol. O:
Date 6-28-73
Bielefeld
Field Sol.

APPROVED
AS TO FORM
THF
LEGAL DEPT.

APPROVED:

Lower Yellowstone Irrigation
District No. 1

By

ATTEST

Secretary

(SEAL)

INTAKE WATER COMPANY

By
Vice President

ATTEST

(SEAL)
ASSISTANT Secretary

APPROVED:

Lower Yellowstone Irrigation
District No. 2

By

ATTEST

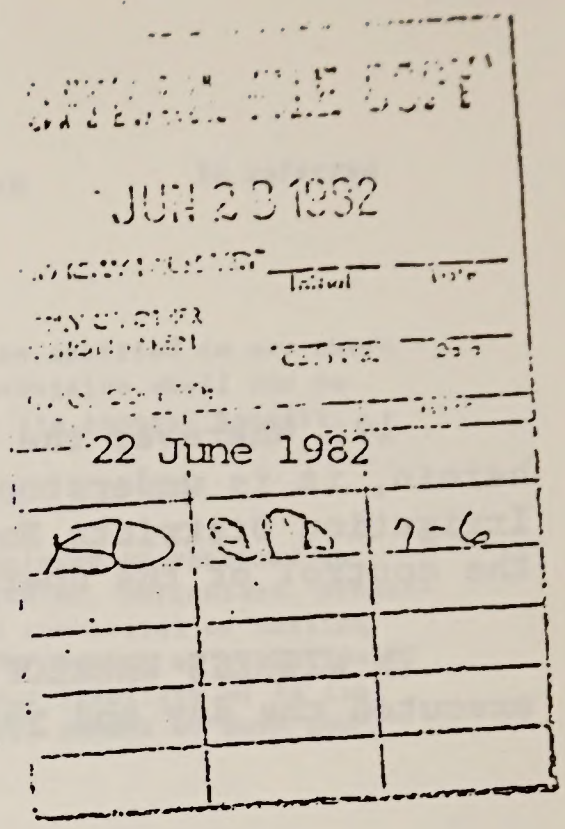
Secretary

(SEAL)

DEPARTMENT OF THE ARMY
OMAHA DISTRICT CORPS OF ENGINEERS
6014 U.S. POST OFFICE AND COURTHOUSE
OMAHA NEBRASKA 68102

REPLY TO
ATTENTION OF:

402 221 3020



MROPD-M

EXHIBIT B-2

E.P. (Lee) Denson
Bureau of Reclamation
P.O. Box 2553
Billings, MT 59103

Dear Mr. Denson:

We have reviewed the Preliminary Draft EIS for the Yellowstone Diversion Project and offer the following comments for your consideration.

We find that the document clearly discusses the Federal actions involved including those by the Corps of Engineers.

The document appears to adequately discuss the impacts of the proposed project with one exception. The document lacks a discussion on cumulative effects. Refer to CEQ Guidelines, paragraph 1508.7.

Thank you for the opportunity to comment.

Sincerely,

FOR ARVID L. THOMSEN
Chief, Planning Division

United States Department of the Interior

IN REPLY REFER TO
1790

BUREAU OF LAND MANAGEMENT
Miles City District Office
P.O. Box 940
Miles City, Montana 59301

JUN 1 · 1982

OFFICIAL FILE COPY

JUN 14 1932

NO REPLY NECESSARY — Initials — Date

REPLY OR OTHER ACTION TAKEN

INFO. COPY TO: K[illegible], Echo

ROUTE TO	[illegible]	
150	[illegible]	6-14

EXHIBIT B-3

Lee Denson
Bureau of Reclamation
P.O. Box 2553
Billings, Montana 59103

Dear Mr. Denson:

A review of the P.D.E.I.S. for the Intake Water Company, Yellowstone Diversion Project by our staff shows no major deficiencies. We would like to suggest a map showing private and federal ownership. It could be overlaid on Figure II-1. A legend would also enhance that figure.

Sincerely yours,

James K Muelson
District Manager

ACTING

APPENDIX C - ENVIRONMENTAL COMMITMENTS

C. ENVIRONMENTAL COMMITMENTS

A list of environmental commitments which would be implemented, should permits for the project be granted, is presented below. These commitments have been made through coordination and consultation of IWC, BR, USFWS, and MDFWP.

- o The dam and associated facilities would be designed to safety standards which would protect against flooding;

- o Construction activities in the flood channel would be conducted during dry periods to limit areas of disturbance and soil erosion;

- o Construction of a gravel all-wheather road on Joe's Island with the approximate existing contour so as not to impede flood or ice flows;

- o Dam construction design to minimize seepage and associated potential impact;

- o Fencing of construction areas for protection of domestic livestock;

- o Monitor Yellowstone River flow utilizing electronic sensing to automatically shut down pumping during low or critical flow conditions, in the event of river screening malfunctions, or when the reservoir reaches capacity;

- o Salvage of topsoil from disturbed areas to be used in reclamation;

- o Revegetation of disturbed areas with approved seed mixtures and planting of trees for screening of facilities;

- o Use of existing access to project facilities where possible. Design of access bridge to Joe's Island to include total span or single pillar support minimizing potential for jamming of ice and debris;

- o Construction of heli-pad for maintenance and emergency access during periods of high water;

- o Construction of the transmission line utilizing conductor spacing to prevent accidental electrocution of birds;

- o Seeding, riprapping and other stabilization measures for erosion control during construction and operation;

- o Assisting in the maintenance and operation of the low-head dam to assure that the LYID would not be impacted by the YDP diversion;

- o MDFWP will be allowed to utilize lands not needed for project purposes as wildlife management areas (Exhibit C-1);

- o Incorporating "state of the art" design into the intake structure to reduce potential impacts of entrainment and impingement of fish and fish eggs. IWC has also agreed to allow studies to be performed on its effectiveness and will operate the instrumentation pursuant to recommendations resulting from the studies as long as it does not adversely affect the pumping regime (Exhibit C-2);

- o Allow 5000 cfs instantaneous minimum flow to pass the point of diversion during April and May to protect downstream fish spawining habitat as long as it does not interfere with IWC's water rights.

IWC will also notify MDFWP of intended pumping plans when river flows fall to or below 5000 cfs during those months (Exhibit C-3). Also, flows will not be reduced below 4400 cfs during the irrigation season when water is needed by the LYID;

- o Assisting MDFWP in the construction of recreational facilities on Joe's Island. The facilities would be constructed at the same time as the YDP facilities using the all-weather road for access. MDFWP will obtain all necessary clearance for the facilities and be responsible for their maintenance (Exhibit C-4);

- o Allowing public access to the reservoir for recreational purposes; however, MDFWP will have sole responsibility of maintenance and policing the facility. IWC will have sole right to the water for beneficial use and limited liability for recreational use of the reservoir as defined in current statutes (Exhibit C-5); and

- o Upon completion, facilities would be painted to blend into the surrounding environment.

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
Billings Area Office
Federal Building, Room 3035
316 North 26th Street
Billings, Montana 59101-1396

IN REPLY REFER TO:

ES

June 23, 1982

Mr. Richard Echols
Intake Water Company
1100 Milam Building
P.O. Box 2511
Houston, TX 77001

Dear Mr. Echols:

This letter outlines our understanding of the informal verbal agreement reached at our May 12, 1982, meeting concerning involvement by the Montana Department of Fish, Wildlife, and Parks (MDFWP) and ourselves in Intake Water Company's (IWC) land acquisition program for the Yellowstone Diversion Project. This "involvement" relates to our earlier recommendations concerning wildlife mitigation for the proposed project. That recommendation dealt primarily with the control of livestock grazing on lands adjacent to the proposed reservoir which IWC may acquire as part of the project.

It is our present understanding that IWC intends to continue informal cooperation with FWS and MDFWP, keeping both apprised of IWC's land acquisition efforts and soliciting their comments and recommendations on certain aspects of the acquisition program. These would include such things as the location of lands being considered for purchase or trade, and possible lease back arrangements on purchased lands. Comments from FWS and MDFWP would address the relative value and suitability of the lands and management options for terrestrial mitigation.

If your understanding of our informal agreement is different, please contact us.

Sincerely,

John G. Wood
Acting Area Manager

cc: Al Elser, Montana Department of Fish, Wildlife, and Parks,
Miles City, MT
Lee Denson, USBR, Billings, MT
Regional Director, USFWS, Denver, CO (ENV)

Intake Water Company
A Tenneco Company

P.O. Box 2511
Houston, Texas 77001
(713) 757-2131

EXHIBIT C-2

May 26, 1982

Montana Department of Fish, Wildlife, and Parks
1420 East 6th Avenue
Helena, Montana 59601

Re: Memorandum of Agreement Between Intake Water Company and Montana Department of Fish, Wildlife, and Parks
Larval Fish Protection

Gentlemen:

The possible impingement and/or entrainment of larval fish as a result of Intake Water Company's (IWC) diversion of water from the Yellowstone River in Dawson County, Montana, is of significant concern. Of particular interest at the IWC diversion site are impacts on larval sauger because two major sauger spawning areas for the lower Yellowstone River are located upstream of IWC's diversion point and it is suspected that larval drift occurs past the proposed pumping station at the point of diversion. Paddlefish and shovelnose sturgeon also spawn upstream of the diversion point.

IWC, in cooperation with the Montana Department of Fish, Wildlife, and Parks (MDFWP), the Fish and Wildlife Service, and the Bureau of Reclamation, has developed an intake structure for installation at the point of diversion considered adequate to avoid potential impingement and/or entrainment of the various larval. The structure presently under consideration involves the use of directional air jets, electronic and bubble screens. Continued cooperation among the parties should ensure that the final design will provide adequate protection for larval fish.

Larval fish drift in Yellowstone occurs seasonally during the time period from April 15 through July 15. Annual and seasonal variation in discharge and water temperature, however, can affect the spawning seasons of the important game fish of the lower Yellowstone River, including the above mentioned species at the IWC Point of Diversion. As a result of these variations, operation of the larval fish protection devices may be desirable at times during the April 15 - July 15 time period.

MDFWP will monitor flows and temperatures in the river to determine when larval fish drift past the IWC pumping station may occur. MDFWP will supply information to IWC and will make recommendations regarding specific times for operation of the larval fish protection devices.

IWC will operate the devices pursuant to these recommendations so long as the operation of such devices does not adversely affect IWC's pumping regime. IWC also agrees to provide MDFWP with an opportunity to conduct monitoring and/or research at the pump station to determine the effectiveness of the devices and to install instrumentation and other devices at MDFWP's sole risk and expense on IWC's facilities. Copies of all data, reports and conclusions shall be furnished IWC at no cost to IWC. Any devices and instrumentation shall be installed in such manner as not to interfere with the operation, maintenance or safety of IWC's facilities.

MDFWP agrees to hold and save IWC harmless and indemnify IWC from any and all claims of any kind or nature whatsoever arising out of or in any way connected with the activities of MDFWP, its officers, agents, employees, business invitees, guests, and contractors at IWC's facilities under the Memorandum of Agreement.

If this letter accurately reflects our understanding, please execute and return the original and three copies for our file.

APPROVED AS TO FORM
MPW 6/4/82
LEGAL DEPT

INTAKE WATER COMPANY

By _____
Agent and Attorney-in-Fact

Accepted and Agreed to this
13 day of July, 1982.

MONTANA DEPARTMENT OF FISH, WILDLIFE AND PARKS

_____
Title: James W Flynn

Intake Water Company
A Tenneco Company

P.O. Box 2511
Houston, Texas 77001
(713) 757-2131

EXHIBIT C-3

May 26, 1982

Montana Department of Fish, Wildlife, and Parks
1420 East 6th Avenue
Helena, Montana 59601

Re: Memorandum of Agreement Between Intake Water Company and Montana Department of Fish, Wildlife, and Parks Spawning Habitat Protection

Gentlemen:

Monitoring by Montana Department of Fish, Wildlife, and Parks (MDFWP) of sauger and walleye spawning in the Yellowstone River near the proposed Intake Water Company (IWC) Yellowstone Diversion Project has shown that reductions in flow in the river below 5,000 cfs could result in dewatering of eggs, increased silt deposition, and a reduction in the number of spawning fish on major spawning sites. Sauger and walleye spawning and incubation occurs in the lower Yellowstone River during April and May of each year and the parties to this agreement recognize the importance of these fishery resources and hereby declare their intention to protect them to the extent practicable.

Historically, both mean and median flows in the Yellowstone River during April and May are well above 5,000 cfs, although low flows below this level have been recorded. IWC has indicated that both April and May are probable pumping months, and that pumping could be terminated for up to 90 consecutive days during full operation of the project. Such operational flexibility is designed to protect prior downstream water rights.

IWC will operate its pumping facilities so as to maintain a 5,000 cfs Rate of Flow in the Yellowstone River at its Point of Diversion on the Yellowstone River, during the months of April and May, so long as the operation of such pumping facilities that maintain that rate of flow in the Yellowstone River does not interfere with IWC's pumping regime and planned rate of withdrawal from the Yellowstone River for storage and beneficial use. In this connection IWC's right to the use of waters of the Yellowstone River is in no way to be construed as limited or restricted by the terms of this Memorandum of Agreement. IWC, in its sole judgement, shall make the determination as to whether or not the operation of IWC's pumping facilities in such a manner as to maintain that rate of flow in the Yellowstone River interferes with IWC's pumping regime and planned rate of withdrawal. Further this Memorandum of Agreement shall not be construed to preclude IWC, in its sole discretion, from diverting water from the Yellowstone River in such a manner as to reduce the rate of flow in the Yellowstone River below 5,000 cfs in April and May in any given year, when maintaining that rate of flow interferes with IWC's pumping regime and planned rate of withdrawal, provided IWC does not interfere with prior downstream rights in doing so.

IWC will endeavor to maintain the desired 5,000 cfs instantaneous minimum flow for April and May at the pumping station. Should flows in the river fall to or below 5,000 cfs at the pump station during April and May, IWC will notify MDFWP of the level of flow and of its intended pumping plans for the next 10 days.

The specified coordination is intended to enable MDFWP to make such recommendations as they feel are appropriate to protect fish spawning and incubation and to monitor impacts that may occur to the fishery resource during the period of low flow. IWC agrees to the MDFWP recommendations, to the extent practicable consistant with the provisions of the Memorandum of Agreement.

If this letter accurately reflects our understanding, please execute and return the original and three copies for our file.

APPROVED
AS TO FORM
MPW 6/8/82
LEGAL DEPT.

INTAKE WATER COMPANY

By Richard L. Echols
Agent and Attorney-in-Fact

Accepted and Agreed to this
13 day of July, 1982.

MONTANA DEPARTMENT OF FISH, WILDLIFE AND PARKS

James W. Flynn
Title:

Intake Water Company
A Tenneco Company

P.O. Box 2511
Houston, Texas 77001
(713) 757-2131

EXHIBIT C-4

May 26, 1982

Montana Department of Fish, Wildlife, and Parks
1420 East 6th Avenue
Helena, Montana 59601

Re: Memorandum of Understanding Between Intake Water Company and Montana Department of Fish, Wildlife and Parks Recreational Development Plan

Gentlemen:

Intake Water Company (IWC) plans to construct a bridge across the flood channel and an all weather access road across Joe's Island to its proposed Yellowstone Diversion Project pump station. In so doing, IWC recognizes that a valuable fishing area will be opened up for public use. Therefore, IWC and Montana Department of Fish, Wildlife and Parks will jointly finance (50-50 basis) and at the time of its project construction, IWC will construct a Road and Parking Lot as follows:

1. Rough grade and gravel cap with bank run gravel if necessary, a road extending from IWC's main road to the Yellowstone River.

2. Rough grade and gravel cap with bank run gravel if necessary, a 50 car parking lot in the vicinity of the Yellowstone River.

3. Rough grade and gravel cap with bank run gravel if necessary, a loop road at the river and parking lot area to allow automobiles to turn around.

This construction is conditioned upon MDFWP securing all necessary permits, authorizations, and clearances in a timely manner, and furnishing such to IWC so that construction can commence concurrently with the IWC project. Should all permits not be obtained prior to construction of IWC's project road, IWC shall have no duty to perform hereunder. IWC shall have no duty to maintain the herein proposed road but same shall be the responsiblity of MDFWP.

EXHIBIT C-4 (Concluded)

If this letter accurately reflects our understanding, please execute and return the original and three copies for our file.

INTAKE WATER COMPANY

APPROVED
AS TO FORM
MPW 6/3/82
LEGAL DEPT.

By Richard F Eckel
Agent and Attorney-in-Fact

Accepted and Agreed to this
13 day of July, 1982.

MONTANA DEPARTMENT OF FISH, WILDLIFE AND PARKS

James W Flynn
Title:

Intake Water Company
A Tenneco Company

P.O. Box 2511
Houston, Texas 77001
(713) 757-2131

EXHIBIT C-5

May 26, 1982

Montana Department of Fish, Wildlife, and Parks
1420 East 6th Avenue
Helena, Montana 59601

Re: Memorandum of Agreement Between
Intake Water Company and
Montana Department of Fish, Wildlife and Parks

Gentlemen:

Intake Water Company (IWC) plans to construct an offstream water storage Reservoir to be known as Box Elder Reservoir in Dawson County, Montana, to store and beneficially use waters of the Yellowstone River (The Reservoir). The Montana Department of Fish, Wildlife and Parks (MDFWP) has proposed that IWC allow public access to the reservoir for recreational purposes including fishing and boating, to which proposal IWC agrees on the following terms:

1. MDFWP shall stock and maintain fish in the reservoir at MDFWP's sole cost and expense.

2. MDFWP will not allow boats on said reservoir with motors of any kind or character; provided, however, IWC and MDFWP may operate boats with motors on the reservoir.

3. MDFWP shall police the reservoir to insure public compliance with the laws of the State of Montana including the laws regulating fishing and boating and to insure that the public utilizes the reservoir for recreational purposes only.

4. MDFWP shall provide and maintain trash receptacles at the reservoir site and arrange for trash removal on a regular basis at its sole expense.

5. MDFWP shall not allow any vehicular traffic around the reservoir, including but not limited to cars, trucks, motorbikes and motorcycles, except for public access to and from the reservoir at access sites designated by IWC.

6. MDFWP acknowledges that said reservoir is constructed by IWC to provide water for IWC's beneficial use and such beneficial use shall hold precedence over any other use of the reservoir by MDFWP or the public.

7. MDFWP recognizes that the level of the reservoir will fluctuate based on IWC's use of the waters of the reservoir and any use of the reservoir as a recreational facility is subordinated to IWC's use of the reservoir for its own purposes.

8. IWC receives no consideration for the use of the reservoir for recreational purposes and IWC and MDFWP acknowledge that the reservoir is available and open to the public only to the extent that the liability of IWC is limited by the provisions 70-16-301 and 70-16-302, MCA. In the event these statutes are amended or construed by the courts in such a manner as to subject IWC to liability greater than the liability IWC has under these statutes as they presently exist, or these statutes are repealed, then IWC shall be entitled at its election to close the reservoir to public use, and IWC shall be under no further obligation to provide the public with access to the reservoir for recreational purposes under this Memorandum of Agreement.

If this letter accurately reflects our understanding, please execute and return the original and three copies for our file.

APPROVED
AS TO FORM
DNRW 6/14/82
LEGAL DEPT

INTAKE WATER COMPANY

By Richard L Eckel
Agent and Attorney-in-Fact

Accepted and Agreed to this
13 day of July, 1982.

MONTANA DEPARTMENT OF FISH, WILDLIFE AND PARKS

James W Flynn
Title:

APPENDIX D - ENVIRONMENTAL SUPPORTING INFORMATION

TABLE D-1

WATER WELL INVENTORY

BOX ELDER CREEK DRAINAGE BASIN

EH&A Well #	Location (Township Range Section Tract)	Owner	Year Completed	Total Depth (ft)	Ground Surface Elevation (ft-msl)	Depth to Static Water Level (ft)	Perforated Interval (ft)	Diameter of Well (in)	Use*	Remarks
1	18N57E 29DDBD	Temple, Carl C.	1945	500	2070	250		6	SH	Reported yield of 12 gpm
2	18N57E 25	Sehlens, Larry	1976	60	2160	25	40-45	8	H	Reported yield of 3 gpm
3	18N58E 32DCDC	Hutchinson, Clarence	1958	122	2300	95		6	S	Reported yield of 5 gpm
4	17N58E 09BA	Hutchinson, Clarence	1958	122	2230	12		7	S	Reported yield of 6 gpm
5	17N57E 12DBBB	Hutchinson, Hildron	1956	201	2370	180		4	S	Reported yield of 3 gpm
6	17N56E 12C	Toepke, Wes	1977	220	2300	135	160-170	6	S	Reported yield of 6 gpm
7	17N56E 28CDC	Larimer, D. C.	1912	120	2400	120		6	HS	Reported yield of 6 gpm
8	17N56E 34BA	Larimer, D. C.	1912	120	2410	120		6	HS	Reported yield of 6 gpm
9	17N57E 29BCAC	Temple, Carl, et al.	1910	100	2210	40		36	HS	Reported yield of 12 gpm
10	17N57E 29ACCC	Temple, Carl, et al.	1910	48	2230	40		4	HS	Reported yield of 12 gpm
11	16N56E 02CAA	Wood, C. E.	1956	55	2330	12		6	S	Reported yield of 5 gpm
12	16N57E 05CBC	TBar, Ponderosa	1978	220	2460	120	80-220	7	S	Reported yield of 4 gpm
13	16N57E 05DA		1972	193	2460	62	70-90	6	S	Reported yield of 5 gpm
14	16N57E 05DC		1976	196	2520	80	166-196	8	S	Reported yield of 10 gpm
15	16N57E 08A	Schepers, Fred	1978	140	2530	110	120-140	8	S	Reported yield of 12 gpm
16	17N58E 30D	Milliron, W. L.	1961	270	2430	180		4	S	Reported yield of 8 gpm
17	17N58E 24CCA	Diamond A Ranch, Inc.	1978	1025	2300	35		10	HS	
18	17N58E 36ADCB	Weyer, Bobbie	1980	100	2430	30	55-95	9	S	Reported yield of 5 gpm
19	16N58E 06	J. J. Land Cattle	1976	880	2300	20		5	HS	Reported yield of 20 gpm
20	16N58E 06AD		1959	833	2350	5		4	S	Reported yield of 5 gpm
21	16N58E 06DDD	Milliron, Willis	1956	835	2300	20		4	SH	Reported yield of 10 gpm

TABLE D-1 (Continued)

EH&A Well #	Location (Township Range Section Tract)	Owner	Year Completed	Total Depth (ft)	Ground Surface Elevation (ft-msl)	Depth to Static Water Level (ft)	Perforated Interval (ft)	Diameter of Well (in)	Use*	Remarks
22	16N58E 07CAA	Milliron, Willis	1960	70	2440	31		15	S	Reported yield of 8 gpm
23	16N58E 09CBBA		1966	31	2330	18		5	S	Reported yield of 7 gpm
24	16N59E 08BDAD	Dukart, John	1959	50	2490	15		18	S	Reported yield of 50 gpm
25	16N57E 14DA	Hilliard, Robert	1946	50	2590	12		7	S	Reported yield of 7 gpm
26	16N57E 13D	Hilliard, Steve	1979	220	2490	90	75-95	6	S	Reported yeild of 3 gpm
27	16N59E 18ACA	Amster, G. D.	1967	176	2620	96		6	S	Reported yield of 4 gpm
28	16N59E 16CA	Stass, C. H.	1972	142	2660	119	127-135	6	S	Reported yield of 6 gpm
29	16N57E 24C	Hilliard, Steve	1979	82	2530	25	62-83	8	H	Reported yield of 8 gpm
30	16N58E 20BDDD		1965	165	2530	127		5	S	Reported yield of 7 gpm
31	16N58E 22DA		1968	217	2490	150		8	S	Reported yield of 8 gpm
32	16N58E 24BDD	Leland, Alvin J.	1943	150	2530	30		—	SH	Reported yield of 5 gpm
33	16N59E 19DCC	Dukart, John	1980	300	2560	85	140-160	11	Q	Reported yield of 7 gpm
34	16N59E 20CDC	Dukart, John	1967	132	2560	68		4	S	Reported yield of 5 gpm
35	16N59E 29AB	Dukart, John	1967	265	2560	125		6	S	Reported yield of 7 gpm
36	16N57E 25CA	Rakes, Roy	1960	48	2620	38		18	S	Reported yield of 4 gpm
37	15N58E 05AD	Shultz Bros. Inc.	1980	53	2660	25	33-53	6	S	Reported yield of 4 gpm
38	15N58E 05CABB	Rakes, Roy	1951	170	2690	120		6	S	Reported yield of 1 gpm
39	15N58E 09BC	Cook, Jerry	1981	200	2730	121	121-141	7	Q	Reported yield of 5 gpm
40	15N58E 09DC	Nix, Joe	1981	180	2646	100		7	Q	Reported yield of 5 gpm
41	15N58E 10BCDD	Rakes, Roy	1951	180	2590	140		6	S	Reported yield of 2 gpm
42	15N58E 01CCBA	Cale, Gene	1973	142	2530	12	122-142	8	S	Reported yeild of 3 gpm
43	15N59E 06CDD	Burman, A.	1968	202	2650	68	181-188	4	SH	Reported yield of 7 gpm
44	16N59E 25BC	Staggs, E.	1965	120	2620	60		5	S	Reported yield of 5 gpm
45	15N59E 01AAAC	Staggs, E.	1960	60	2640	45		18	S	Reported yield of 4 gpm

TABLE D-1 (Concluded)

EH&A Well #	Location (Township Range Section Tract)	Owner	Year Completed	Total Depth (ft)	Ground Surface Elevation (ft-msl)	Depth to Static Water Level (ft)	Perforated Interval (ft)	Diameter of Well (in)	Use*	Remarks
46	15N59E 12BAAA	Staggs, E.	1960	38	2660	30		18	SH	Reported yield of 4 gpm
47	15N59E 02DDCD	Farm Staip	1966	260	2710	150		6	S	Reported yield of 10 gpm
48	15N59E 10A	Wood, S.	1963	270	2760	160	240-270	8	S	Reported yield of 10 gpm
49	15N59E 15BDCA	Lynn, T.	1953	135	2710	128		4	S	Reported yield of 8 gpm
50	15N59E 22CAAB	Anderson, I. & A.	1961	40	2740	20		18	S	Reported yield of 2 gpm
51	15N59E 21ACCC	Anderson, I. & A.	1965	190	2810	40		—	S	Reported yield of 5 gpm
52	15N59E 19DBBA	Job, John	1961	50	2760	20		18	S	Reported yield of 2 gpm
53	15N58E 24BBB		1976	160	2710	90	120-160	10	S	Reported yield of 15 gpm

* Use of water - S, stock; H, domestic; Q, aquaculture (fish farms).

TABLE D-2

PERIODS OF RESTRICTED PUMPING FOR THE YDP FACILITY

SIDNEY GAGE

PERIOD OF RECORD (29 YEARS) 1952-1980

Water Year	Number of Days No Pumping		Number of Days Restricted Pumping*		Total
	Irrigation	Non-irrigation	Irrigation	Non-irrigation	
1952	--	7	--	--	7
1953	--	4	1	--	5
1954	--	14	2	--	16
1955	29	--	1	--	30
1956	--	5	--	--	5
1957	--	--	--	--	--
1958	--	--	--	--	--
1959	--	--	--	1	1
1960	41	9	2	--	52
1961	68	6	2	3	79
1962	--	9	--	--	9
1963	--	7	--	1	8
1964	--	7	--	--	7
1965	--	--	--	--	--
1966	20	--	5	--	25
1967	--	--	--	--	--
1968	--	--	--	--	--
1969	--	--	--	--	--
1970	--	--	--	--	--
1971	--	--	--	--	--
1972	--	--	--	--	--
1973	--	--	--	--	--
1974	--	--	--	--	--
1975	--	--	--	--	--
1976	--	--	--	--	--
1977	--	--	--	3	3
1978	--	7	--	1	8
1979	--	--	--	--	--
1980	--	--	--	--	--

*Pumping restricted below the maximum rate of 200 cfs.

TABLE D-3

PERIODS OF RESTRICTED PUMPING FOR THE YDP FACILITY

MILES CITY GAGE

PERIOD OF RECORD (52 YEARS) 1930-1981

Water Year	Number of Days No Pumping		Number of Days Restricted Pumping*		Total
	Irrigation	Non-irrigation	Irrigation	Non-irrigation	
1930	--	3	--	4	7
1931	63	--	--	2	65
1932	--	14	3	9	26
1933	8	10	4	--	22
1934	74	--	4	--	78
1935	35	12	11	6	64
1936	27	15	3	6	51
1937	46	19	--	--	65
1938	2	--	1	--	3
1939	37	1	2	--	40
1940	53	11	--	--	64
1941	3	7	2	2	14
1942	18	9	6	--	33
1943	--	2	--	--	2
1944	--	--	3	--	3
1945	--	7	--	1	8
1946	7	6	3	--	16
1947	--	4	--	--	4
1948	11	--	6	--	17
1949	19	1	3	2	25
1950	--	2	--	3	5
1951	--	--	--	--	--
1952	--	1	--	--	1
1953	1	--	9	--	10
1954	4	2	1	--	7
1955	30	--	2	--	32
1956	--	5	--	--	5
1957	--	7	--	--	7
1958	--	--	--	--	--
1959	2	2	8	--	12

TABLE D-3 (Concluded)

Water Year	Number of Days No Pumping		Number of Days Restricted Pumping*		Total
	Irrigation	Non-irrigation	Irrigation	Non-irrigation	
1960	45	9	8	--	62
1961	68	5	2	--	75
1962	--	4	--	1	5
1963	--	5	3	--	8
1964	--	1	--	1	2
1965	--	1	--	--	1
1966	31	--	6	--	37
1967	--	--	--	--	--
1968	--	--	--	--	--
1969	--	--	--	--	--
1970	--	--	--	--	--
1971	--	--	--	--	--
1972	--	--	--	--	--
1973	--	--	--	--	--
1974	--	--	--	--	--
1975	--	--	--	--	--
1976	--	--	--	--	--
1977	12	--	2	--	14
1978	--	4	--	1	5
1979	--	--	--	--	--
1980	--	--	--	--	--
1981	5	--	8	--	13

*Pumping restricted below the maximum rate of 200 cfs.

TABLE D-4

MAXIMUM PUMPING RATE OF 200 CFS FOR 30 DAYS AS A PERCENT OF TOTAL MONTHLY FLOWS FOR AVERAGE, LOW, AND HIGH WATER

Years - Period of Record 1929-1970

Month	Percent[1] of Monthly Avg. 1929-1970	Percent[2] of 1934 Flow	Percent[3] of 1961 Flow	Percent[4] of 1965 Flow
October	2.7	3.7	4.4	2.9
November	3.0	3.8	4.2	2.8
December	3.7	5.0	6.6	3.9
January	4.0	3.9	4.6	2.8
February	3.5	3.5	4.2	2.5
March	1.7	3.5	3.8	2.1
April	1.9	3.0	7.1	1.0
May	1.3	1.4	3.7	1.0
June	0.7	1.5	0.9	0.4
July	1.0	4.9	4.0	0.4
August	2.8	7.3	12.5*	1.3
September	3.4	6.7	2.6	1.8

[1] Period of record measured at Sidney.

[2] Low flow year, as measured at Miles City.

[3] Low flow year, as measured at Sidney.

[4] High flow year, as measured at Sidney.

* Note: In theory, no greater than 9.1% of the instantaneous flow would be taken (no withdrawals when flows at the point of diversion would be 2000 cfs or less).

TABLE D-5

Effect of 200 CFS Withdrawal on Loss of Wetted Streambed at River Flows of 10,000 - 2,000 CFS

River Flow (CFS)	2,000		3,000		4,000		5,000		6,000		7,000		8,000		9,000	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
% Bankfull Wetted perimeter	51.4		57.1	57.1	68.6	64.3	74.3	65.7	78.3	67.1	82.9	68.6	85.7	69.7	88.6	70.6
% less 200 cfs	50.3		54.3	56.0	65.7	62.9	73.1	65.4	77.4	66.9	81.7	68.3	85.1	69.4	87.4	70.3
% change	1.1		2.8	1.1	2.9	1.4	1.2	0.3	0.9	0.2	1.2	0.3	0.6	0.3	1.2	0.3
Change in feet Wetted perimeter	12.5		32.8	12.5	32.8	16.0	13.8	3.3	9.8	2.3	13.8	3.3	6.6	3.3	12.5	3.3
Change in acres/ mile	1.5		4.0	1.7	4.0	2.0	1.7	0.4	1.2	0.4	1.7	0.4	0.8	0.4	1.5	0.4

A - based on profiles downstream of the Intake diversion dam.
B - based on profiles between the IWC diversion and the Intake diversion dam.

TABLE D-6

Summary of the physical parameters measured on miscellaneous sites on the Yellowstone River between Terry and Intake.

	August-October				November-February				March-April				May-July			
	N	Min	Max	Med	N	Min	Max	Med	N	Min	Max	Med	N	Min	Max	Med
Flow	9	8300	14,700E	10,800	6	6000E	10,200	8295	4	9430	15,500	13,300	10	9760E	61,500E	26,200
Temp	10	6.5	22.8	19.0	9	0.0	3.5	0.0	4	0.5	16.5	9.0	17	10.5	24.6	16.1
pH	12	8.0	8.8	8.5	9	7.97	8.6	8.3	4	7.70	8.3	8.15	17	7.5	8.40	8.09
SC	11	478	840	570	10	686	910	760	4	560	1144	878	16	290	910	475
TDS	9	315	508	418	8	467	564	535	4	441	847	609	17	173	514	349
Turb	6	6	230	15	5	10	45	30	2	190	>1000	--	11	40	280	205
TSS	8	12	147	24.5	3	8	84	78	2	61.4	118	84.7	13	90	1930	740
DO	12	8.0	12.0	9.4	9	11.3	13.8	12.6	4	7.4	11.2	10.1	17	7.1	10.0	9.0
BOD	5	0.9	2.5	2.5	3	2.9	3.8	3.0	2	1.6	3.9	2.3	13	0.6	6.3	3.9
FC	4	2	29,400	22,350	3	10	32	19	1	--	--	104	10	<10	855	300
Ca	9	39	59	51	8	58	75	63	4	50	71	70	17	25	59	41
Mg	9	15	23	20	9	15	28	25	4	23	38	30	17	7.8	23	16
TH	9	161	240	210	8	212	300	254	4	220	333	295	17	95	240	170
Na	9	40	70	55	8	56	75	65	4	65	123	90	17	19	66	44
K	7	2.8	4.0	3.4	8	3.4	4.1	3.7	3	4.3	4.8	4.5	13	2.0	3.6	2.7
SAR	9	1.4	2.0	1.6	8	1.5	2.0	1.8	4	1.9	2.9	2.3	17	0.9	1.8	1.4
HCO_3	9	145	195	177	8	184	235	196	4	169	214	213	17	93	174	140
TA	8	119	160	146	9	151	193	158	4	139	176	175	17	76	143	115
SO_4	9	120	191	180	8	175	270	210	4	190	372	280	17	57	220	136
Cl	9	5.5	13	8.2	8	5	15	13	4	15	31	20	17	3.2	13	8.0
F	7	0.1	0.4	0.4	8	0.3	0.4	0.4	3	0.4	0.6	0.6	17	0.2	0.7	0.3
N	9	0.0	0.21	0.02	7	0.2	0.5	0.36	4	0.18	0.32	0.25	16	0.03	0.52	0.27
P	9	0.0	0.28	0.03	7	0.0	0.06	0.04	4	0.01	1.4	0.30	17	<.01	1.5	0.41

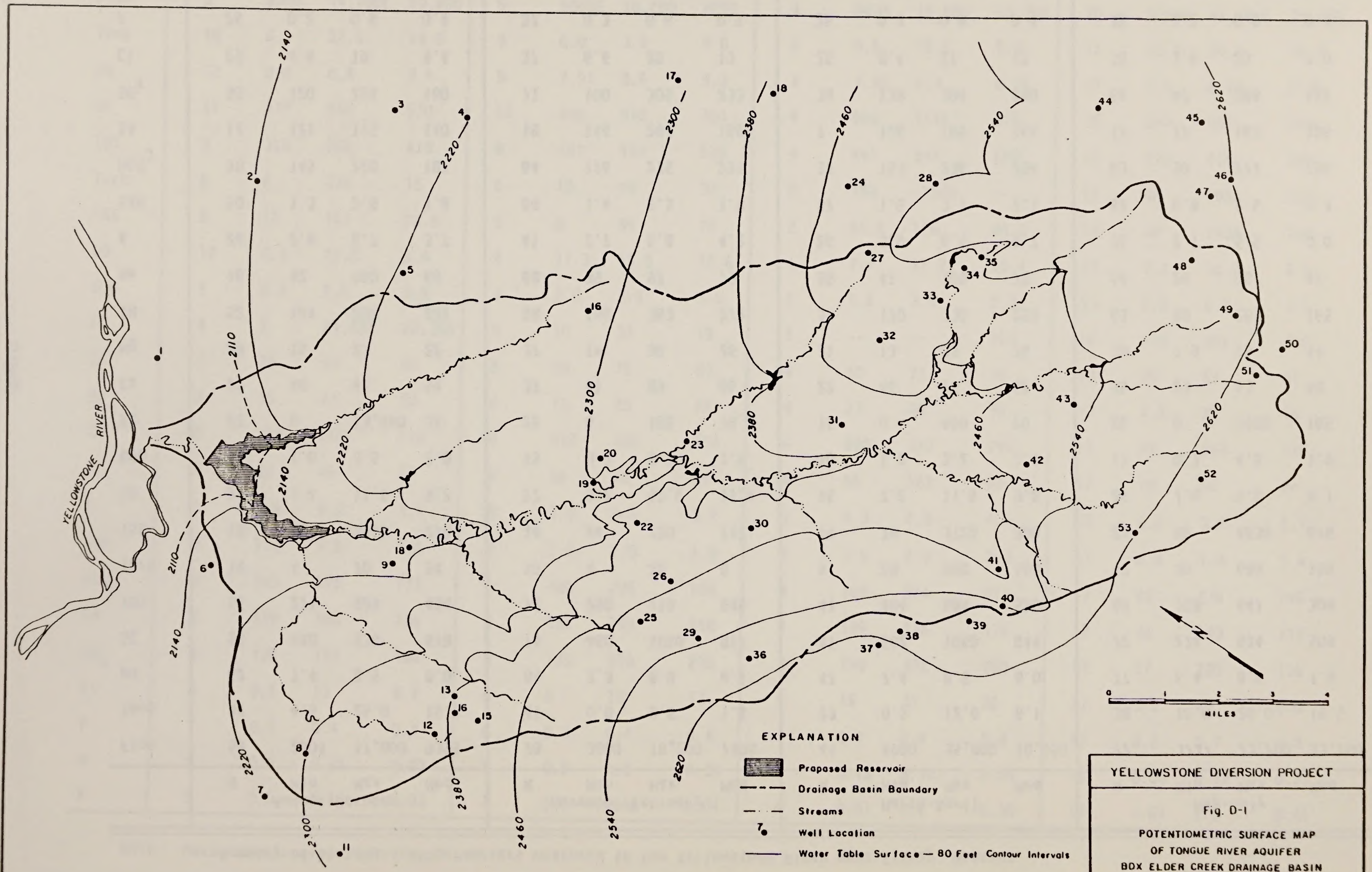
NOTE: Measurements expressed in mg/l.

TABLE D-7

Summary of the physical parameters measured in the Yellowstone River near Sidney, Montana.

	August-October				November-February				March-April				May-July			
	N	Min	Max	Med	N	Min	Max	Med	N	Min	Max	Med	N	Min	Max	Med
Flow	56	2804	17,000	9395	78	3080	18,200	7408	44	4900	35,800	10,050	72	3737	73,200	23,750
Temp	34	4.5	25.0	15.3	41	0.0	8.5	1.5	23	0.5	12.0	6.1	38	10.0	26.0	19.5
pH	62	7.4	8.9	8.0	84	7.3	8.9	8.1	47	7.4	8.5	8.0	77	6.4	8.6	7.9
SC	56	440	939	678	74	460	1050	817	41	562	1050	844	72	274	934	509
TDS	55	271	629	434	72	280	719	545	41	404	684	570	69	158	647	309
Turb	14	4	70	24	15	4	70	8	9	28	920	100	17	30	680	195
TSS	18	20	2910	274	14	44	270	117	14	79	3120	300	23	82	4630	676
DO	25	7.4	11.6	9.2	27	9.2	12.6	11.4	15	7.2	11.6	9.8	26	7.0	9.8	8.1
BOD	14	1.0	3.5	2.0	15	0.7	5.3	1.5	10	1.2	3.2	2.1	17	0.7	4.5	1.9
FC	21	0	13,400	36	22	0	108	10	15	0	400	20	26	0	2500	165
Ca	27	40	62	54	37	41	89	65	22	46	78	62	35	23	63	40
Mg	29	15	27	22	37	14	36	26	21	13	33	26	38	7.9	29	14
TH	52	164	291	222	68	160	363	279	37	170	330	259	63	90	283	165
Na	48	42	100	60	68	39	97	73	35	47	100	78	64	20	96	42
K	26	2.8	6.7	3.7	41	2.7	5.8	4.2	26	3.9	6.4	4.7	36	2.1	5.5	3.0
SAR	50	1.3	2.6	1.8	68	1.4	2.3	1.9	37	1.5	3.1	2.1	62	0.9	2.5	1.4
HCO_3	50	145	220	187	64	126	275	221	37	153	236	204	63	90	277	156
TA	17	121	175	140	18	144	204	168	7	126	185	164	17	77	167	105
SO_4	50	120	224	180	71	100	305	233	38	139	304	240	68	47	288	124
Cl	29	4.4	19	9.4	37	6.6	20	13	25	8.4	21	15	38	3.6	23	7.0
F	26	0.2	0.8	0.4	37	0.3	0.6	0.5	25	0.3	0.8	0.4	38	0.2	0.6	0.4
N	36	0.0	0.39	0.02	44	0.0	0.60	0.30	30	0.0	0.6	0.16	51	0.0	0.69	0.15
P	33	0.0	0.24	0.06	38	0.0	0.17	0.04	21	0.01	1.4	0.18	34	0.01	2.7	0.30

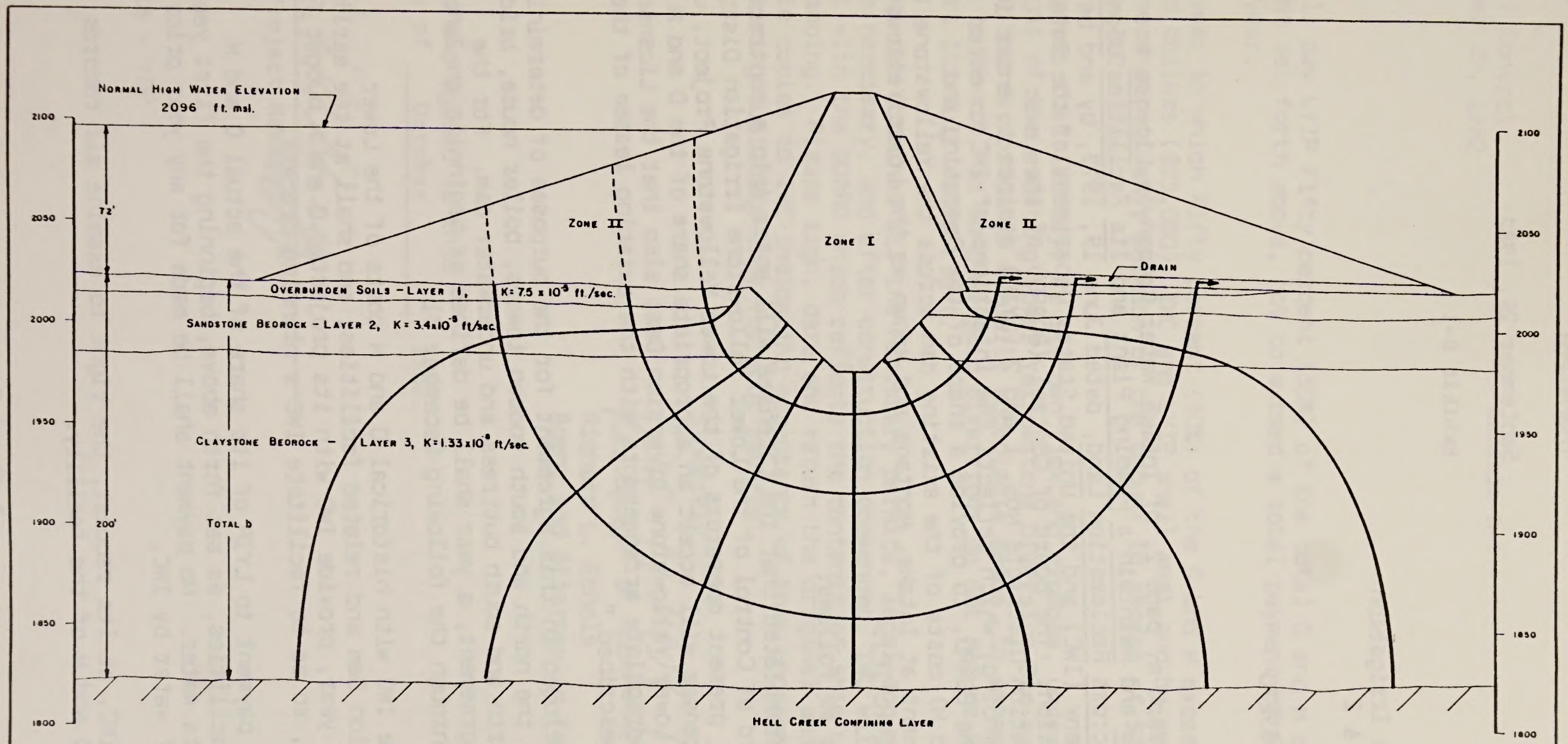
NOTE: Measurements expressed in mg/l.



YELLOWSTONE DIVERSION PROJECT

Fig. D-1

POTENTIOMETRIC SURFACE MAP
OF TONGUE RIVER AQUIFER
BOX ELDER CREEK DRAINAGE BASIN



$$K_e = \text{equivalent permeability coefficient} = \frac{\text{Total } b}{\frac{b_1}{K_1} + \frac{b_2}{K_2} + \frac{b_3}{K_3}} = 1.63 \times 10^{-6} \text{ ft/sec.}$$

0 50 100
FEET

YELLOWSTONE DIVERSION PROJECT

Fig. D-2

GENERALIZED FLOW DIAGRAM
BELOW PROPOSED DAM

Intake Water Company
A Tenneco Company

P.O. Box 2511
Houston, Texas 77001
(713) 757-2131

September 29, 1982

Exhibit D-1

Board of Control
Lower Yellowstone Irrigation
Project Nos. 1 & 2
P.O. Box 112
7th Avenue S. W.
Sidney, Montana 59270

Gentlemen:

Pursuant to paragraph e, page 2, of Intake Water Company's License to Construct, Operate and Maintain a Pumping Plant and Its Facilities Upon, Under, Over and Across Reclamation Land, dated June 19, 1973, by and between Intake Water Company (IWC) and the United States Department of the Interior, Bureau of Reclamation. The Board of Control (BOARD) of the Lower Yellowstone Irrigation Districts Nos. 1 and 2 (LYID) desires to enter into a Letter of Understanding, which reflects the intentions of IWC to enter into a contract with the BOARD, to provide a share of the Operating and Maintenance (O and M) costs of the existing dam across the Yellowstone River and related equipment at Intake, Montana and known as the Lower Yellowstone Irrigation Project (LYIP).

Paragrapn e states as follows:

> "It is contemplated that the Licensee will enter into a contract with the Board of Control of the Lower Yellowstone Irrigation Districts Nos. 1 and 2, present operators of the Lower Yellowstone Project, under which the Licensee will accept an appropriate share of the O and M costs of the Lower Yellowstone Diversion Dam; also that the Licensee shall make appropriate arrangements with the existing leasee of the lands above described."

Equipment to be included in this agreement for the purposes of determining O and M expenses are the north and south wooden towers, boiler house, bridge over the gates, north and south buttress and underwater dam. For the purposes of this agreement, a year shall be defined as beginning on January 1 and continuing through the following December 31.

BOARD shall provide IWC with historical O and M costs of the Lower Yellowstone Diversion Dam and related facilities, and shall at the earliest possible date each year, provide IWC with its projected O and M budget for the following year, so as to facilitate IWC's planning process.

IWC shall commence payment to LYIP of its share of the actual O and M expenses for the facilities, as set forth above, beginning the first year IWC actually diverts water. No payment shall be made for any year prior to actual diversion of water by IWC.

BOARD shall allow IWC, at its request, the right to examine all records pertaining to the O and M of the facility.

INTAKE WATER COMPANY

Exhibit D-1

IWC shall pay LYIP Fifty percent (50%) of the total O and M expenses for the equipment set forth above, not to exceed a total payment of $25,000 by IWC in any year.

In any year in which Fifty percent (50%) of the O and M exceeds Twenty-five Thousand dollars ($25,000), IWC and LYIP shall meet and by mutual agreement determine what, if any, portion of the amount in excess of $25,000 is to be borne by IWC.

BOARD agrees that IWC may, at its own risk and expense, undertake to raise the height of the existing Lower Yellowstone Diversion Dam by the addition of flash boards, or other mutually acceptable means, to enhance IWC'S ability to divert, so long as said diversions do not reduce BOARD'S ability to divert its full water right.

After IWC has obtained all the necessary permits, legal documents and licenses necessary, and after construction commences, IWC will enter into a contract with the BOARD which reflects the contents of this Letter of Understanding. Please sign, date and return the original and three duplicate copies to IWC indicating acceptance of this understanding. Retain the remaining duplicate copy for your records.

Sincerely,

Richard L. Echols
Agent and Attorney-in-Fact

APPROVED
AS TO FORM
9/31/82
LEGAL DEPT.

Accepted and agreed to this
5th day of October, 1982.

Title Project Manager

RLE:ac

cc: File - YDP

Exhibit D-2

Right-of-Way Reservoir 2900 ; 53020

Intake Water Co., P. O. Box 2511, Houston, TX 77001

T. 17 N., R. 57 E., PM
Sec. 18: NW¼NE¼

RECEIVED

FEB 25 1982

ESPEY HUSTON & ASSOCIATES
DENVER, COLORADO

Sept. 15, 1981 Apln. filed. kn

Sept. 23, 1981 3 CC, Supr. Resource Evaluation, USGS, Billings, MT

FEB 3 1982

The Director
Bureau of Land Management

Survey information indicates that this land is valuable for SODIUM OIL & GAS COAL that it is without value for other leasable minerals and that the exercise of surface rights thereon would not interfere u reasonably wtih operations under the mineral leasing laws.

George D. Monroe
District Supervisor
for Resource Evaluation
For the Director
Minerals Management Service

RECEIVED
SEP 25 1981
RESOURCE EVAL
BILLINGS, MT

COPY OF SERIAL REGISTER PAGE

Exhibit D-3

MONTANA HISTORICAL SOCIETY

HISTORIC PRESERVATION OFFICE

225 NORTH ROBERTS STREET • (406) 449-4584 • HELENA, MONTANA 59601

October 22, 1981

Mr. Rick Blaskovich
Bureau of Reclamation
P.O. Box 2553
Billings, MT 59103

Dear Mr. Blaskovich:

Re: Yellowstone Diversion Project
UM-152 . 105.

Thank you for the opportunity to review both the Environmental Assessment Report for the above project and its supplemental "Cultural Resource Evaluation, Belle Prairie and Box Elder Reservoir." In accordance with 36CFR800.5, I am providing my comments on the results of Phases I and II, reports on cultural resource investigations.

The literature search and records review provide a good outline of historic and archaeological resources in the project area. It would be worth mentioning under section 2.6.6.1 that the Hagen site was designated a National Historic Landmark in 1966 by the National Park Service.

Fieldwork was conducted in a manner commensurate with the degree of project impact within the prime reservoir site, the proposed alternativ site, and pipeline right-of-way. I concur with the consultant's assessments of site significance that none of the sites or minimal activity loci/isolates found in the study area would qualify for listing on the National Register of Historic Places.

Thank you for consulting with me.

Sincerely,

Marcella Sherfy
Deputy SHPO

DLV/det

APPENDIX E - METRICS CONVERSION

METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

	Symbol	When You Know	Multiply By	To Find	Symbol
Length	in	inches	2.54	centimeters	cm
	ft	feet	0.3048	meters	m
	yd	yards	0.9144	meters	m
	mi	miles	1.6093	kilometers	km
Area	in^2	square inches	6.452	square centimeters	cm^2
	ft^2	square feet	0.0929	square meters	m^2
	yd^2	square yards	0.836	square meters	m^2
	mi^2	square miles	2.591	square kilometers	km^2
	ac	acres	0.4047	hectares	ha
Mass (weight)	oz	ounces	28.349	grams	g
	lb	pounds	0.4536	kilograms	kg
	t	short tons (2,000 lb)	0.9072	tonnes	T
Volume	fl oz	fluid ounces	29.6	milliliters	ml
	qt	quarts	0.9464	liters	l
	gal	gallons	3.7854	liters	l
	ft^3	cubic feet	0.0283	cubic meters	m^3
	yd^3	cubic yards	0.7647	cubic meters	m^3
	ac-ft	acre-feet	1233	cubic meters	m^3
	lb/ac	pounds per acre	4.883	kilograms per hectare	kg/ha
Temperature (exact)	^oF	Degrees Fahrenheit	5/9 (^oF-32)	Degrees Celsius	^oC
Speed	ft/s	feet per second	0.3048	meters per second	m/s
	ft/s	feet per second	1.097	kilometers per second	km/s
	mi/hr	miles per hour	0.447	meters per second	m/s
	mi/hr	miler per hour	1.6093	kilometers per hour	km/hr
	mi/hr	miles per hour	0.8684	knots	kts

METRIC CONVERSION FACTORS

Approximate Conversions from Metric Measures

	Symbol	When You Know	Multiply By	To Find	Symbol
Length	mm	millimeters	0.0394	inches	in
	cm	centimeters	0.3937	inches	in
	m	meters	3.2808	feet	ft
	m	meters	1.094	yards	yd
	km	kilometers	0.6214	miles	mi
Area	cm^2	square centimeters	0.1549	square inches	in^2
	m^2	square meters	1.196	square yards	yd^2
	km^2	square kilometers	0.386	square miles	mi^2
	ha	hectares (10,000 m^2)	2.471	acres	ac
Mass (weight)	g	grams	0.0353	ounces	oz
	kg	kilograms	2.2046	pounds	lb
	T	tonnes (1,000 kg)	1.1023	short tons	t
Volume	ml	milliliters	0.0338	fluid ounces	fl oz
	l	liters	1.0567	quarts	qt
	l	liters	0.264	gallons	gal
	m^3	cubic meters	35.336	cubic feet	ft^3
	m^3	cubic meters	1.308	cubic yards	yd^3
Temperature	^oC	Celsius degrees	9/5 (^oC)+32	Fahrenheit degrees	^oF
Speed	m/s	meters per second	3.281	feet per second	ft/s
	m/s	meters per second	2.237	miles per hour	mi/hr
	km/hr	kilometers per hour	0.6214	miler per hour	mi/hr
	km/hr	kilometers per hour	0.9113	feet per second	ft/s
	kts	knots	1.151	miles per hour	mi/hr

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